Fluids and Lubricants Specifications

All Commercial mtu Series Diesel Engines (including Marine),
DDC S60 Off Highway and Two-Stroke Cycle Engines
Excluding mtu Series 1000-1600, 1800

A001061/45E

A Rolls-Royce solution

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Export Control Information table	
This document is subject to the following export control information:	
DE:	Not subject to export control.

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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.

To improve readability, plural pronouns are used here to refer to a singular subject of any gender.

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.

Notice:

A notice 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 is therefore extremely important. They are defined in these fluids and lubricants specifications.

mtu ValueCare portfolio

Under mtu ValueCare, Rolls-Royce Solutions GmbH offers oils that are approved and tailored to the engine.

Test standards for fluids and lubricants

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:

Monitoring fluids and lubricants

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

http://www.mtu-solutions.com

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

Applicability of this publication

The fluids and lubricants specifications will be amended or supplemented as necessary. Prior to operation, make sure that the most recent version is used. The most recent version can be consulted under:

http://www.mtu-solutions.com

If you have any questions, your 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 hazardous materials. Certain regulations must be obeyed 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 statement on applicable regulations is therefore not possible within these fluids and lubricants specifications.

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

Preservation

All information on preservation, represervation and depreservation, including the approved preservatives, is available in the preservation and represervation specifications (publication number A001070/...). The most recent version can be consulted under:

http://www.mtu-solutions.com

2 Lubricants for Four-Cycle Engines

2.1 Engine oils

Important

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

Requirements for the approval of engine oils by Rolls-Royce Solutions

The Rolls-Royce Solutions conditions for the approval of engine oils for diesel engines are specified in the delivery standards. MTL 5044, MTL 5051 for initial operation and corrosion inhibitor oil and for two-stroke cycle engine oils in delivery standard MTL 5111, and also available under these numbers.

Engine oil manufacturers are notified in writing if their product is approved.

Approved diesel fuel engine oils are divided into the following quality categories.
- Oil category 1: Standard quality/single and multi-grade oils
- Oil category 2: Higher quality/single and multi-grade oils
- Oil category 2.1: Multi-grade oils with a low ash-forming additive content (low SAPS oils)
- 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 phosphorus content and an ash-forming additive content of ≤1%.

They are only approved if the sulfur content in the fuel does not exceed 50 mg/kg. When using diesel particulate filters, it is advisable to use these oils to avoid fast coating of the filter with ash particles. For exceptions, see (→ Page 11).

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

Important

The use of engine oils not approved by Rolls-Royce Solutions can mean that statutory emissions limits can no longer be observed. This can be a punishable offense.

Important

Mixing different engine oils is strictly prohibited!
It is possible to change to a different approved engine oil grade during an oil change. The remaining oil quantity in the engine oil system is insignificant in this regard.
This procedure also applies to the genuine Rolls-Royce Solutions engine oil grades in the regions of Europe, the Middle East, Africa, America and Asia.

Important

When changing to an engine oil in category 3, note that the improved cleaning effect of these engine oils can result in the loosening of engine contaminants (e.g. carbon deposits).
It may therefore be necessary to reduce the oil change interval and oil filter service life (once on changing).

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Special properties

mtu ValueCare diesel fuel engine oils

The following mtu ValueCare single-grade and multi-grade oils are available from Rolls-Royce Solutions in individual regions:

Manufacturer and sales region	Product name	SAE grade	Oil category	Material number
Rolls-Royce Solutions Europe Middle East Africa	DEO SAE 15W-40 Ultra	15W-40	2	20 l canister: X00084315 210 l barrel: X00084316
	Diesel Engine Oil DEO SAE 15W-40 [1)]	15W-40	2	Product replaced by DEO SAE 15W-40 Ultra.
	Power Guard® DEO SAE 40	40	2	20 l canister: X00062816 210 l barrel: X00062817
Rolls-Royce Solutions America Inc. Americas	Power Guard® SAE 15W-40 Off Highway Heavy Duty	15W-40	2.1	5 gallons: 800133 55 gallons: 800134 IBC: 800135
	Power Guard® SAE 40 Off Highway Heavy Duty	40	2	5 gallons: 23532941 55 gallons: 23532942
Rolls-Royce Solutions Asia Asia	DEO SAE 15W-40 Ultra	15W-40	2	20 l canister: 60333/P 210 l barrel: 60335/D
Rolls-Royce Solutions Suzhou Co. Ltd. China	Diesel Engine Oil - DEO 15W-40	15W-40	2	16 kg: X00087293 170 kg: X00087294
	Diesel Engine Oil - DEO 10W-40	10W-40	2.1	20 l canister: X00085025
PT. Rolls-Royce Solutions Indonesia Indonesia	DEO SAE 15W-40 Ultra	15W-40	2	20 l canister: 60333/P 210 l barrel: 60335/D
mtu India Pvt. Ltd. India	DEO SAE 15W-40 ULTRA	15W-40	2	20 l canister: 60333/P 210 l barrel: 60335/D
	Diesel Engine Oil - DEO 15W-40	15W-40	2	20 l canister: 63333/P 205 l barrel: 65151/P
	Diesel Engine Oil - DEO 40	40	2	20 l canister: 73333/P 205 l barrel: 75151/D

Table 2:

[1)] = No longer included in the portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.

Restrictions for applications with Series 2000 and 4000 engines

Series 2000: Cx6, Gx6, Gx7, M41A IMO III, Mx6, M84, M94, Mx7, Sx6

Series 4000-03 Genset (all application groups); 4000: M73-M93L, N43 and N83; 4000-04 C&I; 4000-04 Genset (all application groups); 4000-04 Marine; 4000-04 Oil&Gas; 4000-04 Rail; 4000-05 C&I; 4000-05 Genset (all application groups); 4000-05 Marine; 4000-05 Oil&Gas

Important
Category 1 oils must not be used! Exception: Genset application groups 3A and Bx4x

Restrictions for applications with Series 2000 M72 engines

Important

The following oils must not be used:
- Mobil Delvac 1630/1640
- Mobilgard ADL 30/40
- Power Guard® SAE 40 Off-Highway Heavy Duty
- Mobil Delvac XHP™ Extra 10W-40
- Mobil Delvac Modern™ 10W-40 Super Defense V1

Restrictions for applications with Series 4000 C, R, T engines

Important

In engines in Series 4000 C64, T94 and T94L, only engine oils of oil category 3 or 3.1 of SAE grades 5W-40, 10W-40 or 15W-40 may be used!
Exceptions:
- For Series 4000 T94 and T94L, Chevron Delo 400 LE SAE 15W-40 (oil category 2.1) may also be used.

In engines in Series 4000 R64, R74 and R84, only engine oils of oil category 3.1 of SAE grades 5W-40 or 10W-40 may be used!
In engines in Series 4000 Cx5 and Tx5, only engine oils of oil category 2.1, 3 or 3.1 of SAE grades 5W-40, 10W-40 or 15W-40 may be used!
The maximum oil service life is 1000 operating hours with observance of the analytical limit values for used oils.

Restrictions for applications with Series 8000 engines

Important

Only the following engine oils may be used:
- Castrol HLX SAE 30 / SAE 40
- Chevron Delo 400 SAE 30 / SAE 40
- Mobil Delvac Legend 1630
- Mobil Delvac Legend 1640
- Mobilgard ADL 30 SAE 30
- Mobilgard ADL 40 SAE 40
- PowerGuard® SAE 40 Off-Highway Heavy Duty (Material number: 5 gallons 23532941, 55 gallons 23532942)
- Shell Sirius X SAE 30 / SAE 40

Important

SAE grade 40 engine oil may only be used in conjunction with preheating and oil priming ($T_{OIL>30\ °C}$)!

Restrictions for applications with Series S60 engines

Important

Only multi-grade oils marked with index [2)] in chapter 7 (→ Page 117) may be used in Series S60 engines. These oils have viscosity grade 15W-40 and, for category 2 or 3, they also have at least API specification CH-4. For oils of category 2.1 or 3.1, API specification CJ-4 is also available as a minimum.
The maximum oil service life is 250 operating hours or one year.

Restrictions when using low SAPS oils

Important

Oil categories 2.1 and 3.1 may be used if the sulfur content in the fuel does not exceed 50 mg/kg.
For exceptions, see (→ Page 11)

Restrictions for applications in Series 595 and 1163-02

Important
Category 2 or 3 oils are normally stipulated for fast commercial ferries using Series 595 and Series 1163-02 engines.

Restrictions for applications with Series 956 TB31/TB32/TB33/TB34 and 1163 TB32 engines

Important
Only category 2 and 3 engine oils are generally approved!

At present, only the following engine oils are approved for the engines of Series 956 TB31, TB32, TB33 and TB34 for nuclear power station applications and for Series 1163 TB32:

Series	Oil category 2, single-grade oil	Oil category 2, multi-grade oil	Oil category 3
956 TB31	Power Guard® SAE 40 Off-Highway Heavy Duty Mobil Delvac Legend 1630 Mobil Delvac Legend 1640 Mobilgard ADL 30 SAE 30 Mobilgard ADL 40 SAE 40	No approval	Shell Rimula R6 MS SAE 10W-40 Shell Rimula R6 M SAE 10W-40
956 TB32	Power Guard® SAE 40 Off-Highway Heavy Duty Mobil Delvac Legend 1640 Mobilgard ADL 40 SAE 40	No approval	Shell Rimula R6 MS SAE 10W-40 Shell Rimula R6 M SAE 10W-40
956 TB33 Ɛ = 9	Power Guard® SAE 40 Off-Highway Heavy Duty Mobil Delvac Legend 1640 Mobilgard ADL 40 SAE 40	No approval	Shell Rimula R6 MS SAE 10W-40 Shell Rimula R6 M SAE 10W-40
956 TB33 Ɛ = 12	Power Guard® SAE 40 Off-Highway Heavy Duty Mobil Delvac Legend 1640 Mobilgard ADL 40 SAE 40 Shell Sirius X 30		Shell Rimula R6 MS SAE 10W-40 Shell Rimula R6 M SAE 10W-40

Series	Oil category 2, single-grade oil	Oil category 2, multi-grade oil	Oil category 3
956 TB34	Power Guard® SAE 40 Off-Highway Heavy Duty Mobil Delvac Legend 1640 Mobilgard ADL 40 SAE 40		Shell Rimula R6 MS SAE 10W-40 Shell Rimula R6 M SAE 10W-40
1163 TB32 Emergency power, Genset	Power Guard® SAE 40 Off-Highway Heavy Duty Mobil Delvac Legend 1640 Mobilgard ADL 40 SAE 40 Shell Sirius X 30	No approval	Shell Rimula R6 MS SAE 10W-40 Shell Rimula R6 M SAE 10W-40

Table 3:

Engine oil approvals upon customer request for applications in Series 956 TB 31, TB32, TB33, TB34 and 1163-02 TB32

The engine oil must have valid Rolls-Royce Solutions approval as per MTL 5044 and a quality level of oil category 2 or 3.

For customer certification, an engine test run under the following conditions is required. Individual cylinder test run 50 hours; with positive findings, the engine test run has to be carried out as follows:

- Engine runtime with specific oil: Min. 50 hours (30 hours of this at min. 100% power)
- Then endoscopic examination of combustion chambers.
- Disassembly of four pistons (two on engine A-side and two on engine B-side) for detailed results.

Use of low SAPS oils (oil categories 2.1 and 3.1) with fuels with a maximum sulfur content of 1000 mg/kg in applications in Series 12V2000M41A IMO III, 2000Mx7, 4000M03 IMO II/III, 4000M05 IMO II/III, 8V4000M63 IMO III and 20V4000M53B IMO III

If low SAPS oils of oil categories 2.1 and 3.1 are to be used in conjunction with fuels with a maximum sulfur content of 1000 mg/kg, they must also comply with the following performance requirements in addition to the Rolls-Royce Solutions approvals:

Oil category	Specification	
	ACEA	API
2.1	E7 and E9	CJ-4 and CI-4
3.1	E6 and E7	CI-4

Table 4:

If the low SAPS oils meet the above-mentioned requirements, these oils are approved for a runtime of up to 500 operating hours. If the maximum runtime is exceeded, the base number of the oil must be checked through regular oil analyses. If the permissible base number is fallen below, the oil must be replaced.

Important
If the performance requirements listed in table (→ Table 4) are not met, only fuels with a max. sulfur content of 50 mg/kg may be used.

Engine oils for engines with exhaust gas aftertreatment (EGAT)

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

Depending on the technology used for exhaust gas aftertreatment, the following oils can be used.

Exhaust gas technology	Approval for oil category				
	1	2	2.1	3	3.1
Diesel oxidation catalyst without particulate filter	No	No	Yes	No	Yes
SCR system with vanadium catalysts (no particulate filter)	No	No	Yes	No	Yes
SCR system with zeolite catalysts (no particulate filter)	No	No	Yes	No	Yes
Closed particulate filter	No	No	Yes	No	Yes
Combination system SCR+ particulate filter	No	No	Yes	No	Yes

Table 5:

Important

The use of engine oils of categories 1, 2 and 3 with ash-forming additives >1% on systems with EGAT results in a significantly reduced service life of the exhaust gas aftertreatment system and, with particulate filters, increased back pressure.

Important

Only low-ash engine oils of category 2.1 or 3.1 are permitted for EPA Tier 4i or Tier 4 and EU IIIb-certified engines with exhaust gas aftertreatment.

Any existing restrictions based on engine requirements must also be observed.

Assignment of military engine oil specifications to SAE viscosity grades

Specification	O-236	O-237	O-278	O-1176	O-1178	O-1179	O-1180	O-1236
GER	TL 9150-0063 (Bw Code OY1145)		TL 9150-0031 (Bw Code OY1160)		TL 9150-0080 (Bw Code OY1175)		TL 9150-0107 (Bw Code OY1260)	
UK			DEF STAN 91-22 (OMD-113)	DEF STAN 91-113 (OMD-90)	DEF Stan 91-68 (OMD-55)		OX-90	
FRA	DCSEA 214/C		DCSEA 278	DCSEA 214/C		DCSEA 215/C		
US		MIL-PRF-2104N	MIL-PRF-9000H					MIL-PRF-2104N
Operating temperature [°C]	-20 to +50		+5 to +50	≥ -20	-46 to +35	-35 to +50	-32 to +50	
SAE viscosity grade	15W-40	10W-30/40	40	10W-30		5W-40	10W-40	15W-40
API		CI-4		CH-4/SJ		SL/CI-4	CI-4	CI-4
ACEA	E3/B3		E7		E2	A3/B4-04 7 E7-04	E6	

Specification	O-236	O-237	O-278	O-1176	O-1178	O-1179	O-1180	O-1236
mtu			2				3.1	
Comment	Also suitable as corrosion inhibitor oil							

Table 6:

Selection of viscosity grades

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

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

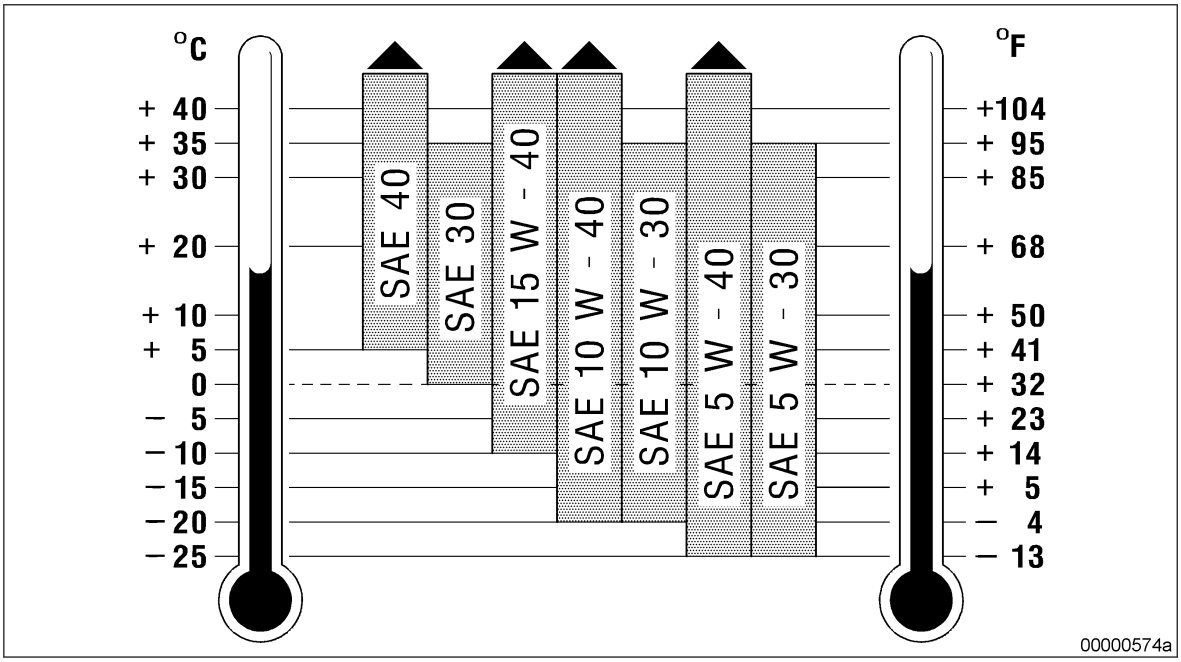

Figure 1: Relationship between viscosity grades and the operating temperature ranges

Oil service life for diesel engines

Oil service life depends on the quality of the engine oil, its conditioning, the operating conditions and the fuel used.

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

Oil change intervals

Oil category	Without centrifugal oil filter	With centrifugal oil filter or bypass filter
1	250 operating hours	500 operating hours
2	500 operating hours	1000 operating hours
2.1[1)]	500 operating hours	1000 operating hours

Oil category	Without centrifugal oil filter	With centrifugal oil filter or bypass filter
3	750 operating hours	1500 operating hours
3.1[1)]	750 operating hours	1500 operating hours

Table 7:

[1)] = To be used in conjunction with fuels with max. 50 mg/kg sulfur content

For exceptions, see (→ Page 11)

Important
The oil change intervals in table (→ Table 7) are recommended guidelines when using diesel fuels with < 0.5% sulfur content. The defined limit values for the used oil (→ Table 8) must be observed. The oil service life quoted for oils must be confirmed by means of oil analysis.

The oil service life must be determined by oil analysis if one or more of the following difficult operating conditions are encountered:
- Extreme climatic conditions
- High engine startup frequency
- Frequent and prolonged idling or low-load operation
- High sulfur content in the fuel of 0.5 to 1.5% by weight (See use of high-sulfur diesel fuel)

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

Where engine oils with higher-grade corrosion-inhibiting characteristics are in use, the oil must be changed every three years at the latest.

In individual cases, the service life of the engine oil can be optimized by regular laboratory analyses and appropriate engine inspections in consultation with the responsible Rolls-Royce Solutions service point:

The first oil sample should be taken from the engine as a "basic sample" after the engine has run for approximately one hour after being filled with fresh oil.

Further samples are to be analyzed at specific intervals (see "Laboratory analysis").

The appropriate engine inspections are to be carried out before and after the oil analyses.
After completion of all inspections, and depending on the findings, special agreements can be reached for individual cases.
Oil samples must always be taken under the same conditions and at the point provided for that purpose (see operating instructions).

Special additives

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

Laboratory analysis

Spectrometric oil analysis

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

Analyses of the wear-metal content to assess the degree of engine wear are not part of the standard procedure. These content levels are very much dependent on the following factors, among others:
- Engine equipment status
- Tolerance scatter
- Operating conditions
- Load profile
- Fluids and lubricants
- 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 provided for wear-metal contents.

The measurement of the wear elements can only be regarded as a monitoring task. A sudden increase is an indication that the oil filter must be checked/inspected. If wear particles are found, an EDX analysis can determine their composition, which helps to identify the affected component.

Used-oil analysis

In order to check the used oil, it is recommended that regular oil analyses be carried out. Oil samples should be taken and analyzed at least once a year and each time the oil is changed. Depending on the application or the operating conditions of the engine, it may be the case that sampling/analysis should take place more frequently.

The specified test methods and limit values (analytical limit values for used diesel engine oils) (→ Table 8) 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 abnormal operating state found.

The limit values relate to individual oil samples. When these limit values are reached or exceeded, an immediate oil change is recommended. 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 state 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 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. mm²/s	ASTM D445 DIN 51659-1 DIN 51659-2 DIN 51659-3	SAE 30 SAE 5W-30 SAE 10W-30	15.0
		SAE 40 SAE 5W-40 SAE 10W-40 SAE 15W-40 SAE 20W-40	19.0
Min. mm²/s		SAE 30 SAE 5W-30 SAE 10W-30	9.0
		SAE 40 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. 3,0 (oil category 1) Max. 3,5 (oil category 2, 2.1, 3 and 3.1)	

	Test method	Limit values
Total base number (mg KOH/g)	ASTM D2896 ISO 3771 DIN 51639	Min. 50% of the fresh oil value
Water content (mg/kg)	ASTM D6304 EN 12937 ISO 6296	Max. 2000
Oxidation (A/cm)[1)]	DIN 51453 [1)]	Max. 25
Ethylene glycol (mg/kg)	ASTM D2982 ASTM D 4291 ASTM D 7922	Max. difference between fresh oil value and used oil value 100
Additive element contents	DIN 51399-1 DIN 51399-2 ASTM D5185	To confirm that the fresh oil is identical to the used oils

Table 8:

[1)] = Only possible if there are no ester compounds

Use of high-sulfur diesel fuel

The following measures must be taken in the case of diesel fuels with a sulfur content above 0.5%:
- Use of an engine oil with a total base number (TBN) of more than 8 mg KOH/g
- Shortening of the oil service life (see "Oil change intervals")
- Shortening of the cylinder head TBO for Series 4000 (→ Page 43)

(→ Figure 2) "Engine oil depending on the sulfur content of the diesel fuel" lists the recommended minimum total base numbers for fresh and used oils depending on the sulfur content of the diesel fuel.

The total base numbers for the approved engine oils are listed in the chapter on "Approved engine oils" (→ Page 117).

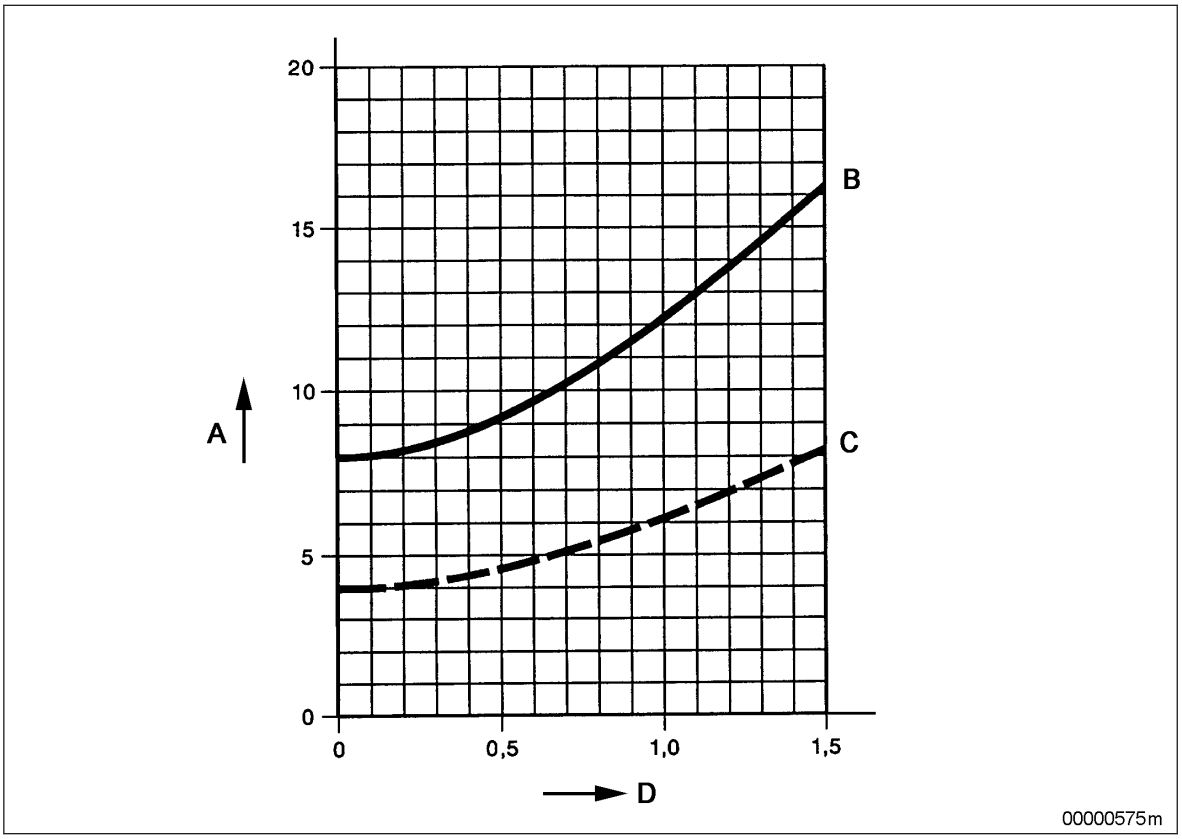

Figure 2: Total base number for engine oil depending on sulfur content of the diesel fuel

A Total base number in mg KOH/g, ISO 3771
B Recommended min. total base number for fresh oil
C Min. total base number for used oil
D Sulfur content of fuel in % by weight

Use of low-sulfur diesel fuel

The use of diesel fuels with low sulfur content (< 0.5%) has no effect on the oil service life.

Minimum requirements for operational checks

Oil analyses can be carried out using the test kit (→ Table 9), which contains all the equipment required as well as instructions for use.

The following analyses can be conducted:
- Determination of oil dispersancy (spot test)
- Determination of diesel fuel content in the oil
- Determination of water content in the oil

Important

Rolls-Royce Solutions recommends the test kit produced by CM Technologies GmbH (/https://www.cmtech-nologies.de).

Table 9:

2.2 Fluorescent dyestuffs for detecting leakage in the lube oil circuit

The fluorescent dyestuffs listed below are approved for detecting leakage in the lube oil circuit.

Manufacturer	Product name	Working concentration	Material number	Container size	Storage stability[1)]
Chromatech Europe B.V.	D51000A Chromatint Fluorescent Yellow 175	0.04% - 0.07%	X00067084	16 kg	2 years
Cimcool, Cincinnati	Producto YFD-100	0.5% - 1.0%		5 gallons (canister) 55 gallons (barrel)	6 months

Table 10:

[1)] = Ex-works delivery, based on original and hermetically sealed containers in frost-free storage (> 5 °C).

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

2.3 Lubricating greases

Requirements

The conditions stipulated by Rolls-Royce Solutions for the approval of lubricating greases are specified in the delivery standard MTL 5050, which can be ordered under this reference number.

Lubricating grease manufacturers are notified in writing if their product is approved.

Lubricating greases for general applications

Lithium-saponified greases are to be used for all lubrication points with the exception of:
- Emergency air-shutoff flaps installed between exhaust turbocharger and intercooler (see Special-purpose lubricants)
- Coupling internal centering

Lubricating greases for applications at high temperatures

High-temperature grease (up to 250 °C) must be used for emergency air-shutoff flaps installed between exhaust turbocharger and intercooler:
- Castrol Braycote Inertox 500-2

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

Greases for internal centerings of couplings

Greases for internal centerings:
- Esso Unirex N3 (stable up to approx. 160 °C)

Special-purpose lubricants

Oils for exhaust turbochargers

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

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

Lubricants for curved tooth couplings

Depending on the application, the following lubricants have been approved for curved tooth couplings:
- - Klüber: Structovis BHD MF (highly viscous lube oil)
- - Klüber: Klüberplex GE11–680 (adhesive transmission lubricant)

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

3 Lubricants for Two-Cycle Engines

3.1 Engine oils

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

Engine oil requirements for two-stroke cycle engines of Series 53/71/92 and 149

Specification	Test method		SAE grade	
			40	50
API CF-2	ASTM	ISO	Limit values	Limit values
Viscosity at 100 °C (mm^2/s)	D445	EN 3104 DIN 51569-1	12.5–16.3	16.3–21.9
Viscosity at 40 °C (mm^2/s)	D445	EN 3104 DIN 51569-1	130–150	200–300
Pour point (°C)	D97	3016	Max. -15	Max. -10
Flashpoint (°C)	D92	2592	Min. 225	Min. 230
Sulfated ash (% by weight)	D874	DIN 51575	Max. 1.0	Max. 0.8
Total base number (mg KOH/g)	D2896	3771	7.0–10.0	Min. 7.0
Calcium (mg/kg)	D5185	DIN 51399-1/-2	No limit value	Max. 500
Phosphorus (mg/kg)	D5185	DIN 51399-1/-2	Min. 700	Max. 100
Zinc (mg/kg)	D5185	DIN 51399-1/-2	Min. 700	Max. 100

Table 11:

Special properties

The following listed two-stroke cycle engine oils are available at Rolls-Royce Solutions America Inc.:

mtu – engine oils for two-stroke cycle engines

Manufacturer and sales region	Product name	SAE grade	Specification	Comments/material number
Rolls-Royce Solutions America Inc. Americas	PowerGuard® Heavy Duty Engine Oil for Detroit Diesel 2-Cycle (4x1G) SAE 40	40	API CF-2	4x1 gallons: 23512701
	PowerGuard® Heavy Duty Engine Oil for Detroit Diesel 2-Cycle SAE 40	40	API CF-2	5 gallons: 23512734 55 gallons: 23512702 IBC: 23512739

Table 12:

Restrictions for Series 53/71/92 applications – all applications except marine

Important
Start failures may occur at ambient temperatures < 0 °C when the engine is operated with SAE grade 40 oils. If no start aids are available, oils of SAE grade 30 may be used as a short-term solution. At lower temperatures (-18 to -32 °C), oils of SAE grade 15W-40 may also be used. These oils must, however, comply with the specification API CF-2 and have a high-temperature viscosity of min. 3.7 cP at 150 °C. The oil grade must be changed back to SAE 40 as soon as temperatures allow.

Restrictions for Series 53/71/92 marine applications

Important
No single-grade oils of SAE grade 30 or multi-grade oils must be used!

Restrictions for Series 53/71/92 applications

Important
For applications with coolant outlet temperatures > 94 °C, oils of SAE grade 50 must be used! If fuels with sulfur contents of 0.5 to 1.0% are used, the oil service life is shortened.

Restrictions for Series 149 applications

Important
For applications with ambient temperatures > 35 °C, oils of SAE grade 50 must be used! SAE grade 50 oils can no longer be recommended at ambient temperatures < 7 °C. If the starting speed is no longer reached with the use of SAE grade 50 oils, oil from SAE grade 40 can also be used. No single-grade oils of SAE grade 30 or multi-grade oils must be used! If fuels with sulfur contents of between 0.5 and 1% are used, oils with a base number of at least 10 mg KOH/g and with zinc and phosphorus contents of max. 100 mg/kg must be used!

Analytical limit values for used diesel two-stroke cycle engine oils

	ASTM	ISO	Limit value SAE 40	Limit value SAE 50
Viscosity at 100 °C (mm^2/s)	D445	EN 3104 DIN 51569-1	Min. 12.5 Max. 16.3	Min. 16.0 Max. 22.0
Soot content (% by weight)	E1131	DIN 51452[1)]	Max. 0.8	Max. 0.8
Water (% by volume)	D1744	EN 12937	Max. 0.3	Max. 0.3
Ethylene glycol	D2982	DIN 51375	Negative	Negative
Iron (mg/kg)	ASTM D5185	DIN 51399-1/-2	Max. 150	Max. 35
Aluminum, silicon, copper (mg/kg)	ASTM D5185	DIN 51399-1/-2	Max. 25	Max. 25
Lead (mg/kg)	ASTM D5185	DIN 51399-1/-2	Max. 10	Max. 10

Table 13:

[1)] = The standard can be used provided that the test procedure for determining the soot content is calibrated such that equivalent results to the thermographic analysis (TGA) according to ASTM E1131 are produced.

Oil change intervals with use of fuels with sulfur content < 0.5%

Application	Series	Oil change interval
C&I, Marine	S 53/71/92	150 h or 1 year
C&I, Marine	S 149	300 h or 1 year
Generator – emergency power	S 53/71/92/149	150 h or 6 months
Generator – continuous operation	S 53/71/92/149	150 h or 3 months

Table 14:

4 Coolants

4.1 General information

Coolant definition

Coolant	= Coolant additive (concentrate) + freshwater in a predefined mixing ratio Ready for application in the engine

The corrosion-inhibiting effect of coolants is only ensured with the coolant circuit fully filled. The only exception is Oil 9156, which maintains its corrosion-inhibiting character even when the coolant was drained due to oil-film formation in the circuit.

Apart from that, only the corrosion inhibitors approved for internal preservation of the coolant circuit provide proper corrosion protection when the medium is drained. This means that, after draining the coolant, the coolant circuit must be preserved if no more coolant is to be added. Refer to preservation and represervation specifications A001070/.. for a description of the preservation procedure.

The residual volume of corrosion inhibitor for internal preservation of the coolant circuit that remains for technical reasons when the engine is drained is unproblematic if it is carried over into the subsequently filled and approved coolant. Provided it has been preserved with Glysacorr® P113 or Glysacorr® P113 FrostProtect yellow as standard. If an emulsion is used, a flushing procedure is required.

Coolants must be prepared from suitable freshwater and a coolant additive approved by Rolls-Royce Solutions. Preparation of the coolant must take place outside the engine.

Important

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

The conditions for the approval of coolant additives are specified in the following delivery standards (MTL):
- MTL 5047: Emulsifiable corrosion inhibitor oil
- MTL 5048: Antifreeze
- MTL 5049: Water-soluble corrosion inhibitor

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

To prevent cooling system damage:

- When topping up (following loss of coolant), ensure that not only water but also concentrate is added. The specified antifreeze and/or corrosion inhibitor concentration must be attained.
- Do not use a corrosion inhibitor concentration of more than 55% by volume (max. antifreeze). Concentrations in excess of this diminish antifreeze protection and heat dissipation.
- The coolant must not contain any oil or copper residue (in solid or dissolved form).
- The majority of corrosion inhibitors currently approved for internal coolant circuit preservation are water-soluble and do not provide antifreeze protection. Make sure that preserved engines are stored safe from frost, because a certain amount of coolant remains in the engine after draining.
- A coolant circuit can usually not 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). The more add-on components there are on the engine, the greater this dilution effect is. Check the coolant concentration in the coolant circuit and adjust as necessary.

Important

All coolants approved in these fluids and lubricants specifications generally relate only to the coolant circuit of mtu engines. In the case of complete drive units, the fluids and lubricants specifications of the component manufacturer must be observed!

Important
To avoid corrosion, it is not permissible to operate an engine with pure water without the addition of an approved corrosion inhibitor!

Special properties

mtu ValueCare – Coolants and premixes

The following mtu ValueCare products were removed from the portfolio at Rolls-Royce Solutions:

Manufacturer and sales region	Product name	Material number
	Antifreeze	
Rolls-Royce Solutions GmbH Rolls-Royce Solutions Asia Europe Middle East Africa Asia	Coolant AO 100 Antifreeze Concentrate	Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AS 100 Antifreeze Concentrate	Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 100 Antifreeze Concentrate	Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 50/50 Antifreeze Premix	Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 40/60 Antifreeze Premix	Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 35/65 Antifreeze Premix	Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant without antifreeze	
	Coolant CS 100 Corrosion Inhibitor Concentrate	Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant CS 10/90 Corrosion Inhibitor Premix	Remaining stocks of this product can be used up as long as they are within their shelf life.

Table 15:

Manufacturer and sales region	Product name	Material number
	Antifreeze	
Rolls-Royce Solutions America Inc. America	Power Cool® Off-Highway Coolant 50/50 Premix	23533531 (5 gallons) 23533532 (55 gallons)
	Power Cool® Universal 50/50 mix	800069 (1 gallon) 800071 (5 gallons) 800084 (55 gallons)
	Power Cool® Universal 35/65 mix	800085 (5 gallons) 800086 (55 gallons)
	Power Cool® 3149 Concentrate	23528572 (55 gallons) 23528571 (1000 l)
	Coolant without antifreeze	
	Power Cool® Plus 6000 Concentrate	23533526 (1 gallon) 23533527 (5 gallons) Colored green

Table 16:

The products from Rolls-Royce Solutions America Inc. are still available.

Notice:

For ready mixtures, the percentage of coolant additive (concentrate) is always named first. Example:
- Coolant AH 40/60 Antifreeze Premix = 40% by vol. coolant additive/60% by vol. freshwater

Notes on mtu ValueCare coolants

Important
The production and distribution of the coolants CS 100 and CS10/90 will be discontinued by RRPS for operational reasons.

The alternative products listed in table (→ Table 17) are compatible when refilling and in the presence of residual quantities when changing coolant.

For all other coolants specified in the RRPS fluids and lubricants specifications, topping up is not permitted and flushing is necessary when changing the coolant brand.

mtu ValueCare – Product name	Alternative products	Manufacturer
Coolant CS 100 Corrosion Inhibitor Concentrate	Power Cool® Plus 6000	Rolls-Royce Solutions America Inc.
	Glysacorr G93 green	BASF SE
	Drewgard XTA	Drew Marine
	Fricofin ME	Fuchs SE
	Zerex G93	Valvoline
	OEM Advanced 93	Valvoline
	York 719	YORK SAS
Coolant CS 10/90 Corrosion Inhibitor Premix	No alternative ready mixture available. CS 100 concentrate must be prepared with appropriate freshwater.	

Table 17:

Important
The production and distribution of the coolant AH 100, and ready mixtures based on it, will be discontinued by RRPS for operational reasons.

The alternative products listed in table (→ Table 18) are compatible when refilling and in the presence of residual quantities when changing coolant.

The products listed in table (→ Table 18) are based on the latest knowledge available at the time of publication of the RRPS fluids and lubricants specifications.

For all other coolants specified in the RRPS fluids and lubricants specifications, topping up is not permitted and flushing is necessary when changing the coolant brand.

mtu ValueCare – Product name	Alternative products	Manufacturer
Coolant AH 100 Antifreeze Concentrate	Glysantin G48 blue green	BASF SE
	Tectrol Coolprotect	BayWa AG
	Castrol Radicool NF	Castrol
	CAR 1 Premium Longlife Kühlerschutz C48	COPARTS Autoteile GmbH
	AVIATICON Finkofreeze F48	Finke Mineralölwerk GmbH
	Fricofin	Fuchs SE
	Alpine C48	Mitan Mineralöl GmbH
	Mobil Antifreeze Extra	Moove Lubricants Limited
	Motorex Coolant G48	Motorex AG
	Nalcool NF48 C	Nalco Water An Ecolab Company
	Roxor Anti-Frost MT-325	LAEMMLE Chemicals AG
	Antifreeze Long Life NF-300 Concentrate	Raloy Lubricantes
	Glacelf MDX	Total Lubrifiants
	Zerex G48	Valvoline
	OEM Advanced 48	
	Hoyer Freeze A48	Wilhelm Hoyer B.V. & Co.KG
Coolant AH 35/65 Antifreeze Premix	Power Cool ® Universal 35/65 mix	Rolls-Royce Solutions America Inc.
Coolant AH 40/60 Antifreeze Premix	Castrol Radicool NF Premix (45%)	Castrol
	Coolelf MDX -26 °C	Total Lubrifiants

mtu ValueCare – Product name	Alternative products	Manufacturer
Coolant AH 50/50 Antifreeze Premix	Power Cool ® Universal 50/50 mix	Rolls-Royce Solutions America Inc.
	XTAR Super Coolant Hybrid NF 50%	Cepsa Comercial Petróleo S.A.U.
	AVIATICON Finkofreeze F48 RM 50/50	Finke Mineralölwerk GmbH
	Fricofin 50	Fuchs SE
	Mobil Coolant Extra Ready -36 °C	Moove Lubricants Limited
	Motorex Coolant G48 Ready to use (50/50)	Motorex AG
	Antifreeze Long Life NF-300 Ready-to-use (50:50)	Raloy Lubricantes
	Coolelf MDX -37 °C	Total Lubrifiants
	Zerex G48 premix 50%	Valvoline
	OEM Advanced 48 premix 50%	
	Hoyer Freeze A48 RM 50:50	Wilhelm Hoyer B.V. & Co.KG

Table 18:

Important
The production and distribution of the coolant AO 100, and ready mixtures based on it, will be discontinued by RRPS for operational reasons.

The alternative products listed in table (→ Table 19), and their ready mixtures listed in chapter 8 (→ Page 175), are compatible when refilling and in the presence of residual quantities when changing coolant.

The products listed in table (→ Table 19) are based on the latest knowledge available at the time of publication of the RRPS fluids and lubricants specifications.

For all other coolants specified in the RRPS fluids and lubricants specifications, topping up is not permitted and flushing is necessary when changing the coolant brand.

mtu ValueCare – Product name	Alternative products	Manufacturer
Coolant AO 100 Antifreeze Concentrate	Antifreeze APN-S	Avia AG
	Glysantin G30 pink	BASF SE
	Glysantin G30 ECO pink BMB 100	
	Classic Kolda UE G30	Classic Schmierstoff GmbH & Co KG
	Drewgard ZX	Drew Marine
	AVIATICON Finkofreeze F30	Finke Mineralölwerk GmbH
	Fricofin G12 Plus	Fuchs SE
	Alpine C30	Mitan Mineralöl GmbH
	Omera Premium Coolant	MJL Bangladesh Ltd.
	Zerex G30	Valvoline
	OEM Advanced 30	
	Hoyer Freeze A30	Wilhelm Hoyer B.V. & Co.KG

Table 19:

Important
The production and distribution of the coolant AS 100, and ready mixtures based on it, will be discontinued by RRPS for operational reasons.

The alternative products listed in table (→ Table 20) and their ready mixtures listed in chapter 8 (→ Page 201) are compatible when refilling and in the presence of residual quantities when changing coolant.

The products listed in table (→ Table 20) are based on the latest knowledge available at the time of publication of the RRPS fluids and lubricants specifications.

For all other coolants specified in the RRPS fluids and lubricants specifications, topping up is not permitted and flushing is necessary when changing the coolant brand.

mtu ValueCare – Product name	Alternative products	Manufacturer
Coolant AS 100 Antifreeze Concentrate	Glysantin G40 pink	BASF SE
	Glysantin G40 ECO pink BMB 100	
	Classic Kolda UE G40	Classic Schmierstoff GmbH & Co KG
	AVIATICON Finkofreeze F40	Finke Mineralölwerk GmbH
	Fricofin DP	Fuchs SE
	Roxor Anti-Frost MT-650	LAEMMLE Chemicals AG
	Puma HD Hybrid Coolant	Puma Energy International S.A.
	Zerex G40	Valvoline
	OEM Advanced 40	
	Hoyer Freeze A40	Wilhelm Hoyer B.V. & Co.KG

Table 20:

4.2 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.
- Avoid copper materials wherever possible or keep their effective surface area to the bare minimum. If copper materials cannot be avoided, purely organically inhibited coolants from the list of approved coolants should be used wherever possible.

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 useful life of a coolant and, possibly, attack the materials installed in the coolant circuit.

Information:

Consult the relevant Rolls-Royce Solutions specialist department in case of doubt about the use of materials on the engine / externally mounted components in coolant circuits.

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4.3 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 for the water are exceeded, hardness or mineral content can be decreased by adding demineralized water.

For preparation of coolant with and without antifreeze:

Item	Minimum	Maximum
Total earth alkalines[1)] (Water hardness)	0 mmol/l 0°d	2.7 mmol/l 15°d
pH value at 20 °C	5.5	8.0
Chloride ions + fluoride ions		100 mg/l
Sulphate ions		100 mg/l
Bacteria		10^3CFU (colony forming unit)/ml
Fungi, yeasts	Not permitted!	

Table 21:

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

1 mmol/l = 5.6°d = 100 mg/kg $CaCO_3$

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

For preparation of emulsifiable corrosion inhibitors:

Item	Minimum	Maximum
Total earth alkalines[1)] (Water hardness)	0.36 mmol/l 2°d	1.8 mmol/l 10°d
pH value at 20 °C	7.0	8.0
Chloride ions + fluoride ions		100 mg/l
Sulphate ions		100 mg/l
Bacteria		10^3CFU (colony forming unit)/ml
Fungi, yeasts	Not permitted!	

Table 22:

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

1 mmol/l = 5.6°d = 100 mg/kg $CaCO_3$

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

If the water is too soft, this can result in foam formation and the water has to be hardened before application by adding hard water. If the water is too hard, this impairs the emulsion stability. This causes increased oil separation and the formation of deposits in the system. Excessively hard water must therefore be softened by blending with soft water.

4.4 Emulsifiable corrosion inhibitor oils

Emulsifiable corrosion inhibitor oils

Emulsions of approved emulsifiable corrosion inhibitor oils (1.0 – 2.0% by volume) and suitable freshwater (→ Page 30) provide adequate corrosion protection.

However, they do not provide antifreeze protection.

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

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

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

Important

Under unfavorable conditions, individual cases of bacterial attack may occur in the emulsifiable corrosion inhibitor oils. Treat the coolant emulsion with biocide in this case! Refer to chapter “Flushing and cleaning specifications for engine cooling circuits” (→ Page 204).

Note:

Slight precipitation may occur where coolant emulsions are used. This is shown by a layer on the surface of the coolant in the expansion tank. This is of no significance provided that the emulsion concentration remains within the specified limit values. Change the coolant in the event of a sudden drop in coolant additive concentration or if the additive is no longer absorbed. If necessary, the engine coolant chambers are to be cleaned, see the chapter “Flushing and cleaning specifications for engine coolant circuits” (→ Page 204).

Emulsifiable corrosion inhibitor oils must not be used in engines of the following series:

- Series 099
- Series 183
- Series 2000
- Series 396
- Series 4000
- Series S60
- Two-stroke cycle engines

Important

The series with application approval for emulsifiable corrosion inhibitor oils are listed in the chapter “Approved coolants” (→ Page 157).

For the following listed serial numbers of the Series 20V956TB33 up to year of manufacture end of 2008 (as per identification plate), only emulsifiable corrosion inhibitor oil must be used:

Serial number	Serial number	Serial number	Serial number	Serial number
5870001	5870002	5870003	5870004	5870005
5870006	5870007	5870008	5870009	5870010
5870011	5870012	5870013	5870014	5870015
5870016	5870017	5870018	5870019	

Table 23:

Special approvals presently in effect remain valid.

Important

The emulsifiable corrosion inhibitor oil must never be used for coolant temperatures >90 °C!

Flushing with water is required after every change to a different coolant product. For preserved engines (new engines, field engines, reserve stock engines, etc.), a flushing run must be carried out prior to filling with engine coolant. The necessary work is described in the chapter “Flushing and cleaning specifications for engine coolant circuits” (→ Page 204).

4.5 Antifreeze

The previous versions of these Fluids and Lubricants Specifications used the term “Corrosion-inhibiting antifreeze”. The term “Antifreeze” is now used in this edition for reasons of clarity.

Antifreeze is necessary for engines without heating facilities and for operation in areas where below-freezing temperatures may occur.

The BASF SE Glysantin G206 product for Arctic regions is no longer available. Stocks of this product may be used up as long as the shelf life has not expired. Please contact your Rolls-Royce Solutions partner.

Most of the antifreezes approved by Rolls-Royce Solutions are based on ethylene glycol.

Approved antifreezes based on propylene glycol are listed in the relevant chapter (→ Page 203).

Provided that they are used in approved concentrations, antifreezes approved by Rolls-Royce Solutions provide effective protection against corrosion, see section “Operational monitoring” (→ Page 36).

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

Important

For approved coolant additives for the individual engine series, refer to chapter “Approved coolants” (→ Page 157).

Special approvals presently in effect remain valid.

Important

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

Marine engines are subject to the following limitations when using antifreezes:

Series 538, 595 and 8000:

The use of antifreezes is not allowed for these engines.

Series 956-01, 956-02, 1163-02, 1163-03, 1163-04:

These engines are equipped with heating units. Because of their cooler capacity, antifreezes must not be used.

Series 099, 183, 396:

Antifreezes may be used with these engines at seawater temperatures up to a maximum of 20 °C max.

Series 2000 and 4000:

On these engines with installed heat exchanger, antifreezes may be used at seawater temperatures up to a maximum of 25 °C. The use of antifreezes is generally allowed on engines with no installed heat exchanger. Ensure that the heat exchanger not installed on the engine is sufficiently dimensioned.

The specified maximum values for the seawater temperatures apply to all engines on a vessel that are cooled with seawater, e.g. drive motor and onboard power generator.

Important

The maximum admissible antifreeze content for Series 2000, model types 00 to 07 in marine applications is limited to 40% by volume.

The possibility of using antifreezes for the above-mentioned series for other applications (e.g. genset, rail) is described in the overview in the chapter “Approved coolants” (→ Page 157).

Note:

Propylene glycol-based antifreezes are stipulated for use in some types of applications. These products have a lower thermal conductivity than the usual ethylene glycol products. This results in a higher temperature level in the engine.

Important

Propylene glycol based coolants (→ Page 203) are approved for Series 4000 model types 01 to 05 used in genset applications.
Restrictions apply to the use of propylene glycol based coolants for various model types in all other Series 4000 applications. See (→ Page 157)

Flushing with water is required at every change to a different coolant product. For preserved engines (new engines, field engines, reserve stock engines, etc.), a flushing run must be carried out prior to filling with engine coolant if the engines were preserved with an emulsifiable corrosion inhibitor. The necessary work is described in the chapter “Flushing and cleaning specifications for engine coolant circuits” (→ Page 204).

4.6 Coolant without antifreeze

The previous versions of these Fluids and Lubricants Specifications used the term “water-soluble corrosion inhibitors”. For reasons of clarity, this publication uses the term “Coolant without antifreeze”. Emulsifiable corrosion inhibitor oils are not covered in this chapter. See chapter “Emulsifiable corrosion inhibitor oils” (→ Page 31)

Coolant without antifreeze is required for higher coolant temperatures and large temperature drops in heat exchangers, e.g. in TB systems (with plate-core heat exchanger) and TE systems in Series 099, 183, 2000, 396 and 4000 engines.

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

Important

For approved coolant additives for the individual engine series, refer to chapter “Approved coolants” (→ Page 157).

Special arrangements presently in effect remain valid.

Important

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

Flushing with water is required at every change to a different coolant product. For preserved engines (new engines, field engines, reserve stock engines, etc.), a flushing run must be carried out prior to filling with engine coolant if the engines were preserved with an emulsifiable corrosion inhibitor. The necessary work is described in the chapter “Flushing and cleaning specifications for engine coolant circuits” (→ Page 204).

4.7 Operational monitoring

Checking the freshwater and continuous monitoring of the coolant are essential for trouble-free engine operation. The freshwater and the coolant should be checked at least once a year or each time they are topped up. This can be carried out with the test kit (→ Table 24) or by an authorized laboratory. The test kit contains all the necessary equipment, chemicals and instructions for use.

Important
Rolls-Royce Solutions recommends the test kit produced by CM Technologies GmbH (/https://www.cmtechnologies.de).

Table 24:

Analysis	Method for on-site checks (Test kit) (→ Table 24)	Method for lab analysis
Determination of the water hardness	Titration	Determination of the Ca and Mg content by means of ICP and calculation of the hardness in °dH or mmol/l
Determination of the pH value	Litmus paper strips for an appropriate measuring range	ASTM D1287
Determination of the chloride content	Titration	IC
Determination of the sulfate content	-	IC
Determination of the silicon content	-	ICP
Determination of additive concentration in aqueous coolant solutions	Brix refractometer, compare degree(s) Brix against table (→ Table 27) and read off concentration in % by volume.	Refractometer method DIN 51423, compare Brix value against table (→ Table 27) and read off % by volume.
Determination of antifreeze concentration	Glycol refractometer, concentration in % by volume can be read off directly	Refractometer method DIN 51423, calculation through refraction index or product-specific factor
Determination of bacterial count for aqueous media	-	Dip slides (tube with culture medium, e.g. by VWR Prolabo No. 535112D or equivalent) incubation time: Four days at 30 °C

Table 25: Minimum requirements and methodology for coolant monitoring

The routine check of the coolant in accordance with table (→ Table 25) identifies minimum requirements. If there are noticeable problems with the coolant with regard to

- Appearance (color, clouding, contamination, etc.)
- Odor

and in the results of the specified examinations, then a laboratory analysis is recommended (see A001080/.. "Handling of laboratory samples"). In case of silicon-containing coolants, the silicon content must generally be checked in the laboratory, because no rapid test that can be applied is available.

Orders for freshwater and coolant analysis may be placed with Rolls-Royce Solutions. In particular cases, operational monitoring can cover more checks that those listed in table (→ Table 25). Please contact your Rolls-Royce Solutions partner if necessary.

Important

On Series 4000-04/-05 engines, an additional exhaust gas cooler is installed and the cooling system reacts more sensitively. A regular check of the coolant is therefore very important to ensure trouble-free engine operation. This check must be carried out annually or after 3000 operating hours and every time the coolant is added.
The concentration, pH value and silicon content (only with coolants that contain Si) must be within the values specified in these fluids and lubricants specifications.

Important

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

Permissible concentrations

	Minimum				Maximum
Emulsifiable corrosion inhibitor oils without antifreeze	1% by volume	–	–	–	2% by volume
Antifreeze based on ethylene glycol	35% by volume	40% by volume	45% by volume	50% by volume	55% by volume
With antifreeze protection up to*	-20 °C	-25 °C	-31 °C	-37 °C	-45 °C
Antifreeze based on propylene glycol	35% by volume	–	–	–	50% by volume
With antifreeze protection up to*	-18 °C	–	–	–	-32 °C

Table 26:

* = Antifreeze specifications determined as per ASTM D1177.

Notice:

Concentration ratios may be subject to certain restrictions depending on the customer, series, model and application concerned (refer to the operating instructions of the engine).

Operational monitoring for permissible concentrations – Coolant without antifreeze

Permissible concentration range	Manufacturer	Product name/brand name	Reading on hand-held refractometer[1] at 20 °C (= degree(s) Brix)					
		% by volume	7	8	9	10	11	12
9 to 11% by volume	Rolls-Royce Solutions	Coolant CS 100 Corrosion Inhibitor Concentrate	3.5	4.0	4.5	5.0	5.5	6.0
		Coolant CS 10/90 Corrosion Inhibitor Premix	3.5	4.0	4.5	5.0	5.5	6.0
	Rolls-Royce Solutions America Inc.	Power Cool® Plus 6000	3.5	4.0	4.5	5.0	5.5	6.0
	BASF SE	Glysacorr G93 green	3.5	4.0	4.5	5.0	5.5	6.0
	CCI Corporation	A 216	4.9	5.6	6.3	7.0	7.7	8.4
	CCI Manufacturing IL Corporation	A 216	4.9	5.6	6.3	7.0	7.7	8.4
	Detroit Diesel Corporation	Power Cool Plus 6000	4.9	5.6	6.3	7.0	7.7	8.4
	Drew Marine	Drewgard XTA	3.5	4.0	4.5	5.0	5.5	6.0
	ExxonMobil	Mobil Delvac Extended Life Corrosion Inhibitor	4.9	5.6	6.3	7.0	7.7	8.4
	Fuchs SE	Fricofin ME	3.5	4.0	4.5	5.0	5.5	6.0
	Ginouves	York 719	3.5	4.0	4.5	5.0	5.5	6.0
	Old World Industries Inc.	Final Charge Extended Life Corrosion Inhibitor (A 216)	4.9	5.6	6.3	7.0	7.7	8.4
	Penske Power Systems	PowerCool Pyroshield-GF Coolant	4.9	5.6	6.3	7.0	7.7	8.4
	Recochem Inc.	HD Expert™ Endurance WB Prediluted Coolant	4.9	5.6	6.3	7.0	7.7	8.4
	Valvoline	Zerex G93	3.5	4.0	4.5	5.0	5.5	6.0
		OEM Advanced 93	3.5	4.0	4.5	5.0	5.5	6.0
7 to 11% by volume	Arteco	Havoline XLI	2.6	3.0	3.4	3.7	4.1	4.4
	Chevron	Delo XLI Corrosion Inhibitor - Concentrate	2.6	3.0	3.4	3.7	4.1	4.4
	Nalco Water An Ecolab Company	Alfloc™ 3443	1.75	2.0	2.25	2.5	2.75	3.0
		Alfloc™ 3477	1.75	2.0	2.25	2.5	2.75	3.0
	Total	WT Supra	2.6	3.0	3.4	3.7	4.1	4.4
3 to 4% by volume	ImproChem	Cool-C18	Please use test kit of manufacturer.					
	Nalco Water An Ecolab Company	Nalcool® 2000						

Table 27:

[1)] = Concentration determined by means of suitable hand-held refractometer

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

Operational monitoring of admissible concentrations, ethylene-glycol-based antifreeze (MEG)/propylene-glycol-based antifreeze (MPG)

The concentration is determined using a suitable glycol refractometer and direct reading of the scale value in % by volume. Care must be taken to read off from the relevant scale when using hand-held refractometers indicating both MEG and MPG scaling.

4.8 Limit values for coolants

pH value when using:			Method
– Emulsifiable corrosion inhibiting oil	Min. 7.5	Max. 9.5	
– Antifreeze	Min. 7.5	Max. 9.0	
– Coolant without antifreeze for engines containing light metal	Min. 7.5	Max. 9.0	ASTM D 1287, ISO 976
– Coolant without antifreeze for engines free of light metal	Min. 7.5	Max. 11.0	

Table 28:

Silicon content in silicon-containing coolants			Method
Silicon	Min. 25 mg/l		ICP

Table 29:

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.

4.9 Coolant concentrates – Storage stability

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

The instructions of the manufacturer must also be observed.

Coolant concentrate	Limit value	Brand name/comments
Emulsifiable corrosion inhibitor oil	12 months	Quaker Houghton Oil 9156
Antifreeze	Approx. 3 years	Observe manufacturer's instructions.
Coolant without antifreeze	2 years	ImproChem Cool-C18 Nalco Nalcool® 2000
	3 years	BASF Glysacorr G93 green Drew Marine Drewgard XTA Fuchs Fricofin ME Ginouves York 719 Rolls-Royce Solutions GmbH Coolant CS100 Rolls-Royce Solutions America Inc. Power Cool® Plus 6000 Nalco Alfloc™ 3477 Valvoline Zerex G93 Valvoline OEM Advanced 93
	5 years	Arteco Havoline XLI CCI Corporation A216 CCI Manufacturing IL A216 Chevron Delo XLI Corrosion Inhibitor Concentrate Detroit Diesel Corp. Power Cool Plus 6000 ExxonMobil Mobil Delvac Extended Life Corrosion Inhibitor Old World Industries Final Charge Extended Life Corrosion Inhibitor (A216) Total WT Supra

Table 30:

Notice:

For reasons of corrosion protection, do not store in galvanized containers. Take this requirement into account when transferring coolant.

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

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

4.10 Color additives to detect leakage in the coolant circuit

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

Approved color additives

Manufacturer	Product name	Material number	Container size	Storage stability[1)]
Chromatech Inc. Chromatech Europe B.V.	D11014 Chromatint Uranine Conc	X00066947	20 kg	2 years
[1)] = Based on original and hermetically sealed containers in frost-free storage (> 5 °C)				

Table 31:

Application:

Add approx. 40 g of dye per 180 l of coolant.

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

The fluorescence (yellow tone) is easily recognizable in daylight. UV light with a wavelength of 365 nm can be used in darker rooms.

5 Liquid Fuels

5.1 Diesel fuels – General information

Important

Dispose of used fluids and lubricants in accordance with local regulations!
Used oil must never be disposed of by adding it to 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 around the world in the quality specified in the tables "Mandatory fuel specifications" (→ Table 32), (→ Table 33) and (→ Table 36) or (→ Page 95) (Mandatory fuel values).
The fuel properties depend on many factors, particularly the region, time of year and storage.

Important

If the fuel is to be stored in storage tanks for an extended period of time, we urgently recommend the use of B0 fuel (biodiesel/FAME-free fuel). This recommendation is supported by a 2015 paper published by the German Federal Office for Information Security entitled "New findings on fuel storage life for standby power systems". This recommendation applies to the use of both fossil and paraffinic diesel fuel. FAME (fatty acid methyl ester) stands for first-generation biodiesel.
Rolls-Royce Solutions provides project-specific consultation on request.
We recommend determining the oxidation stability (EN ISO 12205/ASTM D2274) to check the quality.

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

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

Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)

		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
Density at 15 °C	Min.	D1298 D4052	EN ISO 3675 EN ISO 12185	0.820 g/ml
	Max.			0.860 g/ml
API gravity at 60 °F	Min.	D287 D4052		41
	Max.			33
Viscosity at 40 °C	Min.	D445	EN ISO 3104	1.5 mm²/s
	Max.			4.5 mm²/s
Flashpoint (closed crucible)	Min.	D93	DIN EN ISO 2719	55 °C (60 °C for SOLAS)[1)]

		Test methods		Limit values
		ASTM		
Boiling curve:		D86	EN 17306	
– Initial boiling point				160 to 220 °C
– Volume share 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: [2]		D482	EN ISO 6245	
– Engines without exhaust gas aftertreatment and without exhaust gas recirculation	Max.			0.01% by weight (100 mg/kg)[4]
– Engines with exhaust gas aftertreatment or with exhaust gas recirculation	Max.			0.001% by weight (10 mg/kg)[4]

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		Test methods		Limit values
		ASTM		
Sulfur content: [2]		D5453 D2622	EN ISO 20846 EN ISO 20884	
– Engines without exhaust gas aftertreatment and without exhaust gas recirculation	Max.			0.5% by weight (5000 mg/kg)[4] (→ Page 48)
– Engines with exhaust gas aftertreatment or with exhaust gas recirculation	Max.			0.0015% by weight (15 mg/kg)[4]
Sulfur content: [3]				
– Deviating, but approved sulfur content for certain products				
– Series 2000Bx6/Gx6	Max.			0.05% by weight (500 mg/kg)[4]
– Series 2000Cx0/Cx1/Cx2/Sx0/Sx1/Sx2/Gx5/Px2	Max.			0.05% by weight (500 mg/kg)[4]
– Series 2000Cx6/Sx6/G56F/G56S/G66F	Max.			0.005% by weight (50 mg/kg)[4]
– Series 2000Mx0/Mx1/Mx2/Mx3/Mx4/Mx6/Mx7	Max.			0.05% by weight (500 mg/kg)[4]
– 8V4000M63/20V4000M53B IMO III	Max.			0.1% by weight (1000 mg/kg)[4]
– Series 4000M73-M93L IMO III	Max.			0.1% by weight (1000 mg/kg)[4]
– Series 4000Tx4/R54	Max.			0.005% by weight (50 mg/kg)[4]
– Series 4000Cx5/Tx5	Max.			0.005% by weight (50 mg/kg)[4]
– Series 8000[5]	Max.			0.1% by weight (1000 mg/kg)[4]
– Series 8000[6]	Max.			0.005% by weight (50 mg/kg)[4]
Cetane number	Min.	D613	EN ISO 5165 EN ISO 15195	45
Cetane index	Min.	D976	EN ISO 4264	42
Copper corrosion 3 h at 50 °C	Max. degree of corrosion	D130	EN ISO 2160	1a
Oxidation stability (Rancimat)[7]	Min.		EN 15751	20 hours
Oxidation stability[8]	Max.	D2274	EN ISO 12205	25 g/m³
Lubricity at 60 °C (HFRR value)	Max.	D6079	EN ISO 12156-1	520 µm
Neutralization number	Max.	D974		0.2 mg KOH/g
Microbial contamination				Inadmissible

Table 32:

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

[2] = See series-specific injection and exhaust gas aftertreatment systems (→ Page 52) for the definition as to whether an exhaust gas aftertreatment system is installed.

[3] = If local legislation permits the use of fuel with a sulfur content > 15 mg/kg. If applicable, the use of fuel with a sulfur content > 15 mg/kg voids compliance with the emissions regulations.

[4] = Note: 1% by weight = 10,000 mg/kg = 10,000 ppm

[5] = For engines equipped with cylinder heads with exhaust valve stem seals (from year of manufacture 2012).

[6] = For engines equipped with cylinder heads without exhaust valve stem seals (up to year of manufacture 2012).

[7] = Relevant for diesel fuel with FAME content of ≥ 2% by volume

[8] = Relevant for diesel fuel with FAME content of < 2% by volume

Mandatory fuel specifications for Series 4000Mx5 IMO II and IMO III

		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
Density at 15 °C	Min.	D1298 D4052	EN ISO 3675 EN ISO 12185	0.800 g/ml
	Max.			0.890 g/ml
API gravity at 60 °F	Min.	D287 D4052		45.5
	Max.			27.5
Viscosity at 40 °C	Min.	D445	EN ISO 3104	1.5 mm²/s
	Max.			5.5 mm²/s
Flashpoint (closed crucible)	Min.	D93	DIN EN ISO 27 19	60 °C
Boiling curve:		D86	EN 17306	
– Initial boiling point				160 to 220 °C
– Volume share 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[1]: – Engines without exhaust gas aftertreatment and without exhaust gas recirculation	Max.	D482	EN ISO 6245	0.01% by weight (100 mg/kg)[2]

		Test methods		Limit values
		ASTM		
– Engines with exhaust gas aftertreatment or with exhaust gas recirculation	Max.			0.001% by weight (10 mg/kg)[2)]
Sulfur content: - IMO II	Max.	D5453 D2622	EN ISO 20846 EN ISO 20884	0.5% by weight (5000 mg/kg)[2, 5)]
- IMO III • Rolls-Royce Solutions SCR				0.1% by weight (1000 mg/kg)[2)]
- IMO III • HUG SCR				0.5% by weight (5000 mg/kg)[2, 5)]
Cetane number	Min. Max.	D613	EN ISO 5165 EN ISO 15195	40 53
Cetane index	Min.	D976	EN ISO 4264	42
Copper corrosion 3 h at 50 °C	Max. degree of corrosion	D130	EN ISO 2160	1a
Oxidation stability (Rancimat)[3)]	Min.		EN 15751	20 hours
Oxidation stability[4)]	Max.	D2274	EN ISO 12205	25 g/m³
Lubricity at 60 °C (HFRR value)	Max.	D6079	EN ISO 12156-1	520 µm
Neutralization number	Max.	D974		0.2 mg KOH/g
Microbial contamination				Inadmissible

Table 33:

[1)] = See series-specific injection and exhaust gas aftertreatment systems (→ Page 52) for the definition as to whether an exhaust gas aftertreatment system is installed.

[2)] = Note 1% by weight = 10,000 mg/kg = 10,000 ppm

[3)] = Relevant for diesel fuel with FAME content of ≥ 2% by volume

[4)] = Relevant for diesel fuel with FAME content of < 2% by volume

[5)] = The shortened TBO times of the cylinder head depending on the sulfur content must be taken into account (→ Page 48).

Diesel fuels in winter operation

At low outdoor temperatures, diesel fuel fluidity can be inadequate as a result 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 under the given geographical and other local conditions.

The operating company must ensure that the correct fuel required for the corresponding climatic requirements is always used.

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 comment[1)]
Cloud point		D2500	DIN EN 3015	See comment[2)]

Table 34:

[1)] Filter plugging point or cold filter plugging point (CFPP) denotes the temperature at which a test filter is clogged by precipitated paraffins under defined conditions. 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 first 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.

Operation of fuels with higher sulfur content:

The engines are certified for operation with the fuels approved in these fluids and lubricants specifications.

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

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

Series 4000

When a fuel with sulfur content > 3000 mg/kg is used, the times specified in the maintenance schedule for component TBO of the cylinder head may be reduced, see following table (→ Table 35)

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

Sulfur content in fuel (mg/kg)	TBO cylinder head (h)
<3000	According to maintenance schedule
3000–4500	7000[1)]
4500–5000	5000[1)]

Table 35:

[1)] = If the TBO for the cylinder head specified in the maintenance schedule is shorter, the shorter TBO shall always apply.

Engines with exhaust gas recirculation and/or exhaust gas aftertreatment must not be operated with excessive sulfur content in the fuel. The limit values in the fluids and lubricants specifications apply.

Important
If the sulfur content in the fuel is > 0.5% by weight (> 5000 mg/kg), please consult with Rolls-Royce Solutions GmbH (Application).

When engines are operated with diesel fuels with a sulfur content of more than 0.5% by weight, appropriate engine oils must be used. The criteria for the selection of engine oils can be found in the chapter on "Engine oils" (→ Page 7) under the notes regarding the use of diesel fuels with a higher sulfur content and Figure 2.

Notice:

For safe and efficient engine operation, the limit values specified in (→ Table 32) and (→ Page 46), in particular for water and overall contamination, must be observed for all approved fuel grades at the latest at the interface marked in Fig. 3 Item 6 or, for Series 4000 U83 engines, in Fig. 4 Item 2.

Important

In addition to the limit values specified in (→ Table 32) and (→ Table 33) or (→ Page 95), particle distribution in the fuel according to ISO 4406 must be observed:

Particle distribution	Test method ASTM		Limit values	
			Common Rail	Conventional injection
Particle distribution for fuel between last tank before engine and prefilter (see Fig. 3 Item 5 and Fig. 4 Item 2)	D7619 D7647	Coding of number of particles as per ISO 4406	Max. ISO Code 18/17/14 for 4/6/14 µm particle size	Max. ISO Code 21/20/17 for 4/6/14 µm particle size

Table 36:

Important

The limit values specified in (→ Table 36) must already be observed in the supply 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 GmbH. 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 GmbH is permissible.

General fuel system diagram for diesel engines

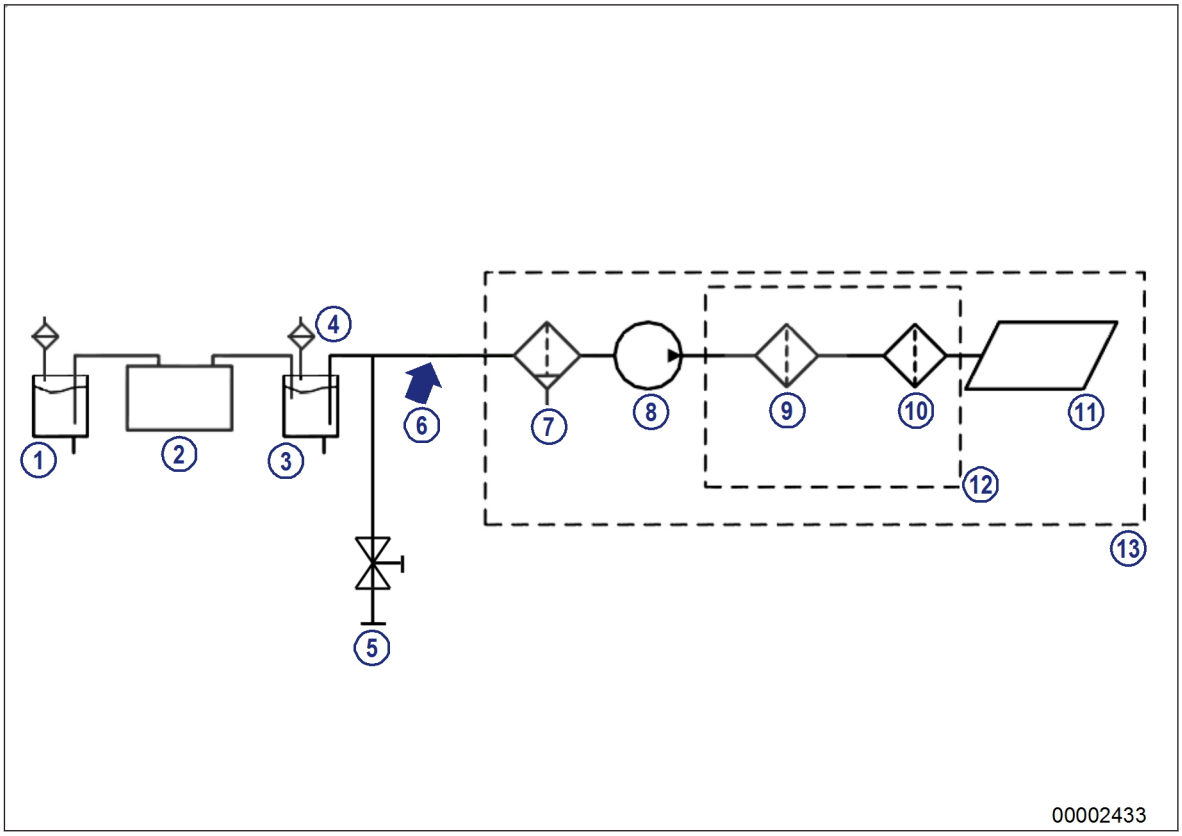

Figure 3:

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

Fuel system diagram for Series 4000U83 diesel engines

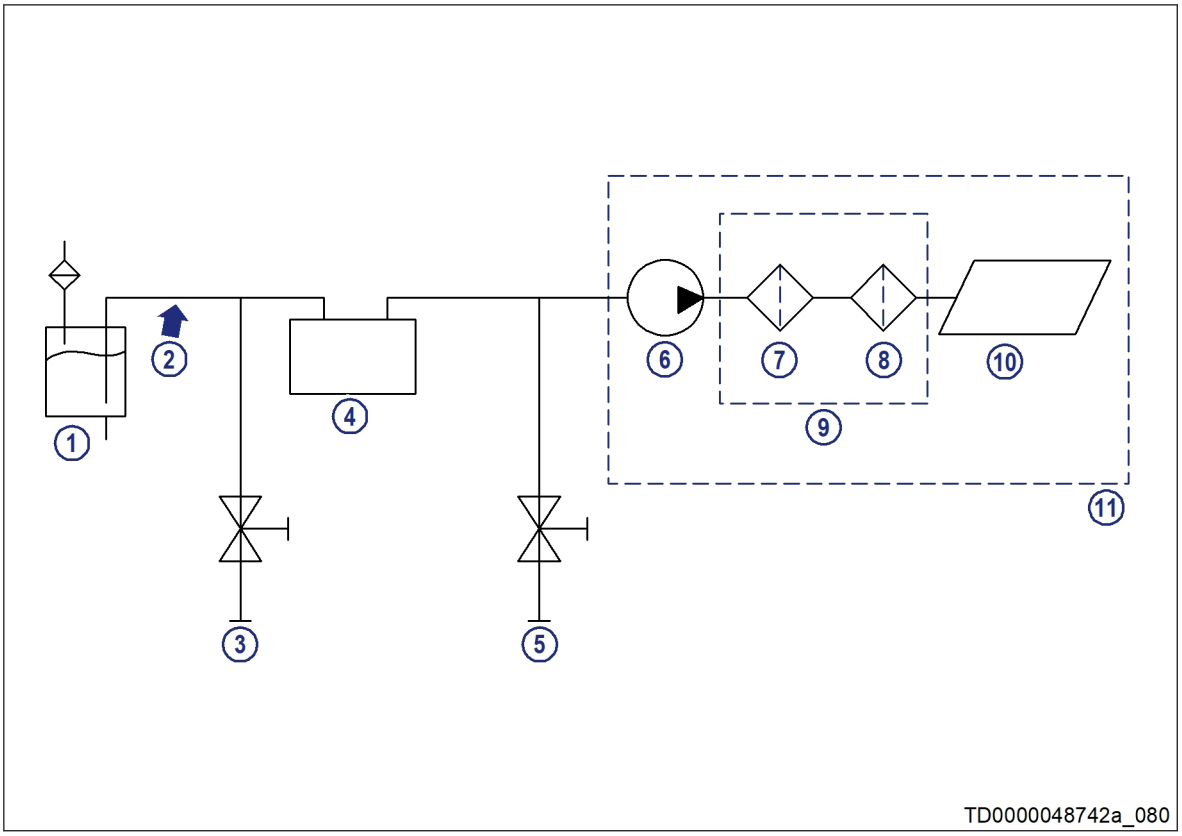

Figure 4:

1 Fuel tank
2 Interface for fuel specification before CJC™ fine filter system (max. 200 mg/kg water content)
3 Sampling point
4 CJC™ fine filter system required
5 Sampling point
6 LP fuel pump
7 Intermediate filter (optional)
8 Primary filter
9 Engine filter
10 Injection system
11 Engine scope of supply

Notice:

In case of poor 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.

Any engine damage or impairment resulting from the use of fuel grades or prefilters other than those approved by Rolls-Royce Solutions in accordance with (→ Table 32) and (→ Table 33) or (→ Page 95), as well as chapter 5.2 (→ Page 53), are not deemed as representing a defect under the terms of the warranty given by Rolls-Royce Solutions GmbH.

Series-related injection and exhaust gas aftertreatment (EGAT) systems

Series	Diesel fuel accumulator injection system (Common Rail)	Conventional injection systems	Exhaust gas aftertreatment (EGAT) system	Exhaust gas recirculation
S60		Yes	No	
099		Yes	No	No
183		Yes	No	No
396 C&I, Genset, Marine, Rail, Submarine		Yes	No	No
538 Marine		Yes	No	No
595 Marine		Yes	No	No
956-01, -02, -03, -04		Yes	No	No
1163-02, -03		Yes	No	No
1163-04	Yes		No	No
2000Cx0, Cx1, Cx2, Gx3, Gx5, Mx0, Mx1, Px2, Sx0, Sx1, Sx2		Yes	Series 2000M41A IMO III only	No
2000Cx6, Gx6, Mx2, Mx3, Mx4, Mx6, Mx7, Sx6	Yes		Series 2000Mx7 only	Series 2000Cx6/ G56F/G56S/ G66F/Sx6 only
4000-00, -01, -02, -03, -04, -05	Yes		Series 4000R64/R74/R84/ Gx5/Mx3 IMO III/Mx5 IMO III/Mx5 EPA T4 only	Series 4000Cx5/Rx4/Tx4/Tx5 only
8000-00, -01	Yes		No	No
Two-stroke cycle engines		Yes	No	No

Table 37:

Laboratory analysis

An order for fuel analysis can be placed with Rolls-Royce Solutions.

The following information is required:
- Fuel specification
- Sampling point
- Serial ID of engine from which fuel sample was taken.

The following is to be supplied:
- 1.0 liters of fuel
- 2.0 liters of fuel (with additional determination of cetane number)

5.2 Series-dependent approval of fuel grades for mtu engines

5.2.1 Distillate fuels according to EN 590 and ASTM D975

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

New series

Fuel specification Restrictions Series	EN 590: 2022-05 Summer and winter quality - SOLAS: Flashpoint min. 60 °C - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	ASTM D975-21 Grade 1-D S 15, S 500, S 5000 - SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	ASTM D975-21 Grade 2-D S 15, S 500, S 5000
S60	Approval issued	Approval issued	Approval issued
2000Cx0, Cx1, Cx2	Approval issued	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 500 mg/kg	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 500 mg/kg
2000Gx5, Gx6	Approval issued		
2000Mx0, Mx1, Mx2, Mx3, Mx4, Mx6, Mx7	Approval issued		
2000Px2	Approval issued		
2000Sx0, Sx1, Sx2	Approval issued		
2000M41A IMO III	Approval issued	Individual case approval	Individual case approval
2000Cx6	Approval issued	Approved if: - The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected	Approved if: - The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected
2000Sx6	Approval issued		

Fuel specification Restrictions	EN 590: 2022-05 Summer and winter quality - SOLAS: Flashpoint min. 60 °C - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	ASTM D975-21 Grade 1-D S 15, S 500, S 5000 - SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	ASTM D975-21 Grade 2-D S 15, S 500, S 5000
Series			
4000-00	Approval issued	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42	Approved if: - Cetane number min. 45 or - Cetane index min. 42
4000-01	Approval issued		
4000-02	Approval issued		
4000-03 C, G, P, R, S	Approval issued		
4000M23F, M23S	Approval issued		
4000M33F, M33S	Approval issued		
4000M53, M53R	Approval issued		
4000M63, M63L	Approval issued		
4000M53B, M73–M93L, N43S, N83	Approval issued		
4000-04 G, M	Approval issued		
4000-05 G	Approval issued		
4000-05 M EPA T4	Approval issued		
4000-05 M IMO II/IMO III	Approved if: - The limit values specified in the table "Mandatory fuel specifications for Series 4000Mx5 IMO II and IMO III" (→ Page 43) are respected	Approved if: - The limit values specified in the table "Mandatory fuel specifications for Series 4000Mx5 IMO II and IMO III" (→ Page 43) are respected	Approved if: - The limit values specified in the table "Mandatory fuel specifications for Series 4000Mx5 IMO II and IMO III" (→ Page 43) are respected
8V4000M63 IMO III	Approval issued	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 1000 mg/kg	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 1000 mg/kg
20V4000M53B IMO III	Approval issued		

TIM-ID: 0000057587 - 011

Fuel specification Restrictions Series	EN 590: 2022-05 Summer and winter quality - SOLAS: Flashpoint min. 60 °C - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	ASTM D975-21 Grade 1-D S 15, S 500, S 5000 - SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	ASTM D975-21 Grade 2-D S 15, S 500, S 5000
12V4000U83	Approval issued: - CJC™ fine filter system required	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42 - CJC™ fine filter system required	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - CJC™ fine filter system required
4000R54, R64, R74, R84	Approval issued	Approved if: - The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected	Approved if: - The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected
4000R54, Tx4	Approval issued		
4000Cx5, Tx5	Approval issued		
8000	Approval issued	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content: The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) for the year of engine manufacture concerned are respected - Viscosity min. 1.5 mm^2/s	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content: The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) for the year of engine manufacture concerned are respected

Table 38:

Classic series

Fuel specification Restrictions Series	EN 590: 2022-05 Summer and winter quality - SOLAS: Flashpoint min. 60 °C - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	ASTM D975-21 Grade 1-D S 15, S 500, S 5000 - SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	ASTM D975-21 Grade 2-D S 15, S 500, S 5000
099	Approval issued	Approval issued	Approval issued
183	Approval issued	Approval issued	Approval issued
396 C&I, Genset, Marine, Rail, Submarine	Approval issued	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42	Approved if: - Cetane number min. 45 or - Cetane index min. 42
538 Marine 595 Marine	Approval issued Anti-wear additive necessary	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg	Approved if: - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg
956TB31, TB32, TB33 956TB34 Nuclear power station, emergency power*	Approval issued Anti-wear additive necessary	Approval issued - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg	Approval issued - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg
956-01 Marine/Rail 956-02 Marine	Approval issued Anti-wear additive necessary	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg	Approved if: - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg

Fuel specification Restrictions Series	EN 590: 2022-05 Summer and winter quality - SOLAS: Flashpoint min. 60 °C - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	ASTM D975-21 Grade 1-D S 15, S 500, S 5000 - SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	ASTM D975-21 Grade 2-D S 15, S 500, S 5000
1163TB32 Genset	Approval issued Anti-wear additive necessary	Approval issued - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg	Approval issued - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg
1163-02 Marine 1163-03 Marine	Approval issued Anti-wear additive necessary	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg	Approved if: - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg
1163-04 Marine	Approval issued	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42	Approved if: - Cetane number min. 45 or - Cetane index min. 42

Table 39:

* = See "Selection of a suitable diesel fuel" (→ Page 43) under "If the fuel is to be stored in storage tanks for an extended period of time".

Two-stroke cycle engines

Fuel specification	EN 590: 2022-05 Summer and winter quality	ASTM D975-21 Grade 1-D S 15, S 500, S 5000	ASTM D975-21 Grade 2-D S 15, S 500, S 5000
Restrictions	- SOLAS: Flashpoint min. 60 °C - Particle distribution for fuel according to table 28 (→ Page 43)	- SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to "Mandatory particle limits" (→ Page 43)	
Series			
S53, S71, S92, S149	Approval issued	Approved if: - Lubricity max. 460 µm	Approved if: - Lubricity max. 460 µm

Table 40:

5.2.2 British Standard

New Series

Fuel specifications Restrictions Series	BS 2869:2017 Part 1 Class A2 - SOLAS: Flashpoint min. 60 °C - Density: Max. 860 kg/m³ - Viscosity: Max. 4.5 mm²/s. If viscosity min. 4.5 mm²/s: Preheating required - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to “Mandatory particle limits” (→ Page 43)	BS 2869:2017 Part 2 Class D
S60	Approval granted	Approval granted
2000Cx0, Cx1, Cx2, Cx6	Not approved	Not approved
2000Gx5, Gx6		
2000Mx0, Mx1, Mx2, Mx3, Mx4, Mx6, Mx7		
2000Px2		
2000Sx0, Sx1, Sx2, Sx6		
4000-00	Approval granted	Approval granted
4000-01		
4000-02		
4000-03C, G, P, R, S		
4000M23F, M23S		
4000M33F, M33S		
4000M53, M53R		
4000M63, M63L		
4000M53B, M73 - 93L, N43S, N83		
4000-04 M		
4000-05 M, IMO II, IMO III	Approved if: - The limit values specified in the table “Mandatory fuel specifications (for Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected	Approved if: - The limit values specified in the table “Mandatory fuel specifications (for Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected
4000-05 M, EPA Tier 4	Not approved	Not approved
12V4000U83	Approval granted: - CJC™ fine filter system required	Approval granted: - CJC™ fine filter system required
4000-04 G	Approval granted	Approval granted

Fuel specifications Restrictions Series	BS 2869:2017 Part 1 Class A2 - SOLAS: Flashpoint min. 60 °C - Density: Max. 860 kg/m³ - Viscosity: Max. 4.5 mm²/s. If viscosity min. 4.5 mm²/s: Preheating required - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to “Mandatory particle limits” (→ Page 43)	BS 2869:2017 Part 2 Class D
4000R64, R74, R84 4000R54, Tx4 4000Cx5, Tx5	Approved if: - The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected	Approved if: - The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected
4000-05 G	Not approved	Not approved
8000	Approval granted	Approved if: - Sulfur content: The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) for the year of engine manufacture concerned are respected

Table 41:

Classic Series

Fuel specifications Restrictions Series	BS 2869:2017 Part 1 Class A2 - SOLAS: Flashpoint min. 60 °C - Density: Max. 860 kg/m³ - Viscosity: Max. 4.5 mm²/s. If viscosity min. 4.5 mm²/s: Preheating required - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to “Mandatory particle limits” (→ Page 43)	BS 2869:2017 Part 2 Class D
099	Approval granted	Approval granted
183	Approval granted	Approval granted
396 C&I, Genset, Marine, Rail, Submarine	Approval granted	Approval granted
538 Marine 595 Marine	Approval granted Anti-wear additive necessary	Approved if: - Sulfur content min. 500 mg/kg

Fuel specifications Restrictions Series	BS 2869:2017 Part 1 Class A2 - SOLAS: Flashpoint min. 60 °C - Density: Max. 860 kg/m³ - Viscosity: Max. 4.5 mm²/s. If viscosity min. 4.5 mm²/s: Preheating required - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to “Mandatory particle limits” (→ Page 43)	BS 2869:2017 Part 2 Class D
956TB31, TB32, TB33 956TB34 Nuclear power station, emergency power*	Approval granted Anti-wear additive necessary	Approved if: - Sulfur content min. 500 mg/kg
956-01 Marine / Rail		
956-02 Marine		
1163-02TB32 Genset	Not approved	Not approved
1163-02 Marine	Approval granted Anti-wear additive necessary	Approved if: - Sulfur content min. 500 mg/kg
1163-03 Marine		
1163-04 Marine	Approval granted	Approval granted

Table 42:

* = See “Selection of a suitable diesel fuel” (→ Page 43) under “If the fuel is to be stored in storage tanks for an extended period of time”.

Two-stroke cycle engines

Fuel specifications Restrictions Series	BS 2869:2017 Part 1 Class A2 - SOLAS: Flashpoint min. 60 °C - Density: max. 860 kg/m³ - Viscosity: Max. 4.5 mm²/s. If viscosity min. 4.5 mm²/s: Preheating required - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined Series- and application-specifically. - Particle distribution for fuel according to “Mandatory particle limits” (→ Page 43)	BS 2869:2017 Part 2 Class D
S53, S71, S92, S149	Approved if: - Lubricity max. 460 µm	Approved if: - Lubricity max. 460 µm

Table 43:

5.2.3 Chinese distillate fuels according to GB 19147-2016, GB 252-2015 and GB 17411-2016

New Series

Fuel specifications	GB 19147-2016 Grade 0 # III: S max. 350 mg/kg IV: S max. 50 mg/kg V: S max. 10 mg/kg	GB 252-2015 Grade 0 #	GB 17411-2016 Grade DMX
Restrictions	- SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Proportion of water: max. 200 mg/kg - Total contamination: max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43) - Neutralization number: Max 0.2 mgKOH/g - Viscosity: at 40 °C: 1.5 to 4.5 mm²)/s		
Series			
S60	Approval granted	Approval granted	Approval granted
2000Cx0, Cx1, Cx2		Approval upon request	Not approved
2000Gx5, Gx6			
2000Mx0, Mx1, Mx2, Mx3, Mx4, Mx6			Approved if: - sulfur content max. 500 mg/kg
2000Mx7			Not approved
2000M41A IMO III	Not approved	Not approved	Not approved
2000Px2		Approval upon request	
2000Sx0, Sx1, Sx2			
2000Cx6	Approved if: - The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected		
2000Sx6			

Fuel specifications	GB 19147-2016 Grade 0 # III: S max. 350 mg/kg IV: S max. 50 mg/kg V: S max. 10 mg/kg	GB 252-2015 Grade 0 #	GB 17411-2016 Grade DMX
Restrictions	- SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Proportion of water: max. 200 mg/kg - Total contamination: max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43) - Neutralization number: Max 0.2 mgKOH/g - Viscosity: at 40 °C: 1.5 to 4.5 mm²)/s		
Series			
4000-00	Approval granted	Approval granted	Approval granted
4000-01			
4000-02			
4000-03 C, G, P, R, S			
4000M23F, M23S			
4000M33F, M33S			
4000M53, M53R			
4000M63, M63L			
4000M53B, M73 - 93L, N43S, N83			
4000-04 M			
4000-05 M IMO II, IMO III	Approved if: - The limit values specified in the table “Mandatory fuel specifications (for Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected	Approved if: - The limit values specified in the table “Mandatory fuel specifications (for Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected	Approved if: - The limit values specified in the table “Mandatory fuel specifications (for Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected
4000-04 G	Approval granted	Approval granted	Not approved
4000-05 G	Not approved	Not approved	Not approved
4000-05 M EPA T4			
8V4000M63 IMO III / EPA T4			
20V4000M53B IMO III	Approval granted	Approval granted	
12V4000U83	Approval granted: - CJC™ fine filter system required	Approval granted: - CJC™ fine filter system required	

Fuel specifications	GB 19147-2016 Grade 0 # III: S max. 350 mg/kg IV: S max. 50 mg/kg V: S max. 10 mg/kg	GB 252-2015 Grade 0 #	GB 17411-2016 Grade DMX
Restrictions	- SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Proportion of water: max. 200 mg/kg - Total contamination: max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43) - Neutralization number: Max 0.2 mgKOH/g - Viscosity: at 40 °C: 1.5 to 4.5 mm²)/s		
Series			
4000R64, R74, R84 4000R54, Tx4 4000Cx5, Tx5	Approved if: - The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected	Approved if: - The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected	Not approved
8000	Approved if: - Sulfur content: The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) for the year of engine manufacture concerned are respected	Approved if: - Sulfur content: The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) for the year of engine manufacture concerned are respected	Approved if: - Viscosity: > 4.5 mm²/s - Preheating required - Sulfur content: The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) for the year of engine manufacture concerned are respected

Table 44:

Classic Series

Fuel specifications	GB 19147-2016 Grade 0 # III: S max. 350 mg/kg IV: S max. 50 mg/kg V: S max. 10 mg/kg	GB 252-2015 Grade 0 #	GB 17411-2016 Grade DMX
Restrictions	- SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Proportion of water: max. 200 mg/kg - Total contamination: max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43) - Neutralization number: Max 0.2 mgKOH/g - Viscosity: at 40 °C: 1.5 to 4.5 mm^2)/s Fatty acid methyl ester content (FAME) content “biodiesel” < 1.0% by volume		
Series			
099	Approval granted	Approval upon request	Approval granted
183			Approval granted
396 C&I, Genset, Marine, Rail, Submarine		Approval upon request	Approved if: - Sulfur content max. 0.5% (5000 mg/kg)
538 Marine	Approval granted Anti-wear additive necessary	Approval upon request	
595 Marine	Approval granted Anti-wear additive necessary	Approval upon request	
956TB31, TB32	Approval granted Anti-wear additive necessary	Approval upon request	Not approved
956TB33, TB34		Approval granted Anti-wear additive necessary	
Nuclear power station, emergency power			
956-01 Marine / Rail	Approval granted Anti-wear additive necessary	Approval upon request	Approved if: - Sulfur content max. 0.5% (5000 mg/kg)
956-02 Marine	Approval granted Anti-wear additive necessary	Approval upon request	
1163-02TB32 Genset	Approval granted Anti-wear additive necessary	Approval upon request	Not approved

Fuel specifications	GB 19147-2016 Grade 0 # III: S max. 350 mg/kg IV: S max. 50 mg/kg V: S max. 10 mg/kg	GB 252-2015 Grade 0 #	GB 17411-2016 Grade DMX
Restrictions	- SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Proportion of water: max. 200 mg/kg - Total contamination: max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43) - Neutralization number: Max 0.2 mgKOH/g - Viscosity: at 40 °C: 1.5 to 4.5 mm²)/s Fatty acid methyl ester content (FAME) content “biodiesel” < 1.0% by volume		
Series			
1163-02 Marine	Approval granted Anti-wear additive necessary	Approval upon request	Approved if: - Sulfur content max. 0.5% (5000 mg/kg)
1163-03 Marine	Approval granted Anti-wear additive necessary	Approval upon request	
1163-04 Marine	Approval granted	Approval upon request	

Table 45:

Two-stroke cycle engines

Fuel specifications	GB 19147-2016 Grade 0 # III: S max. 350 mg/kg IV: S max. 50 mg/kg V: S max. 10 mg/kg	GB 252-2015 Grade 0 #	GB 17411-2016 Grade 0 # I: S max. 10000 mg/kg II: S max. 5000 mg/kg III: S max. 1000 mg/kg
Restrictions	- SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. In the framework of power readjustment, it is possible that the engine operational values change. - Proportion of water: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43) - Neutralization number: Max 0.2 mgKOH/g - Viscosity: at 40 °C: 1.5 to 4.5 mm^2)/s		- SOLAS: Flashpoint min. 60 °C - Density: 0.820 to 0.860 g/ml* * = deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment. - Proportion of water: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43) - Neutralization number: Max 0.2 mgKOH/g - Viscosity: at 40 °C: 1.5 to 4.5 mm^2)/s Fatty acid methyl ester content (FAME) content “biodiesel” < 1.0% by volume
Series			
S53, S71, S92, S149	Approval granted	Approval upon request	Not approved

Table 46:

5.2.4 Heating oil

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

New Series

Fuel specifications	DIN 51603-1:2020-09		DIN 51603-6:2017-03
	Heating oil EL standard	Heating oil EL low-sulfur	Heating oil EL alternative
Restrictions	- SOLAS: Flashpoint min. 60 °C - Cetane number min. 45 or - Cetane index min. 42 - Lubricity max. 520 µm - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)		
Series			
S60	Approval granted	Approval granted	Not approved
2000Cx0, Cx1, Cx2	Approved if: - Density at 15 °C min. 0.820 g/ml - Sulfur content max. 500 mg/kg	Approval granted	Not approved
2000Gx5			
2000Mx0, Mx1			
2000Px2			
2000Sx0, Sx1, Sx2			
2000M41A IMO III	Individual case approval	Approval granted	Not approved
2000Gx6	Approved if: - Sulfur content max. 500 mg/kg	Approval granted	Not approved
2000Mx2, Mx3, Mx4, Mx6, Mx7			
2000Cx6	Not approved	Approved if: - The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected	Not approved
2000Sx6			
4000-00	Approval granted	Approval granted	Not approved
4000-01	Approval granted	Approval granted	Not approved
4000-02	Approval granted	Approval granted	Not approved

TIM-ID: 0000071307 - 008

Fuel specifications Restrictions Series	DIN 51603-1:2020-09 Heating oil EL standard - SOLAS: Flashpoint min. 60 °C - Cetane number min. 45 or - Cetane index min. 42 - Lubricity max. 520 µm - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)	DIN 51603-1:2020-09 Heating oil EL low-sulfur - SOLAS: Flashpoint min. 60 °C - Cetane number min. 45 or - Cetane index min. 42 - Lubricity max. 520 µm - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)	DIN 51603-6:2017-03 Heating oil EL alternative
4000-03C, G, P, R, S	Approval granted	Approval granted	Not approved
4000M23F, M23S	Approval granted	Approval granted	Not approved
4000M33F, M33S			
4000M53, M53R			
20V4000M53B IMO III	Approval granted	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 1000 mg/kg	Not approved
4000M63, M63L	Approval granted	Approval granted	Not approved
8V4000M63 IMO III	Approval granted	Approved if: - Viscosity min. 1.5 mm^2/s - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 1000 mg/kg	Not approved
4000M53B, M73 - 93L, N43S, N83	Approval granted	Approval granted	Not approved
12V4000U83	Approval granted: - CJC™ fine filter system required	Approval granted: - CJC™ fine filter system required	Not approved
4000-04 G	Approval granted	Approval granted	Not approved
4000-04 M	Approval granted	Approval granted	Not approved

Fuel specifications Restrictions Series	DIN 51603-1:2020-09 Heating oil EL standard - SOLAS: Flashpoint min. 60 °C - Cetane number min. 45 or - Cetane index min. 42 - Lubricity max. 520 µm - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)	DIN 51603-1:2020-09 Heating oil EL low-sulfur	DIN 51603-6:2017-03 Heating oil EL alternative
4000-05 G	Not approved	Not approved	Not approved
4000-05 M EPA T4	Not approved	Not approved	Not approved
4000-05 M IMO II, IMO III	Approved if: - The limit values specified in the table “Mandatory fuel specifications (for Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected	Approved if: - The limit values specified in the table “Mandatory fuel specifications (for Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected	Approved if: - The limit values specified in the table “Mandatory fuel specifications (for Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected
4000R64, R74, R84	Not approved	Approved if: - The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected	Not approved
4000R54, Tx4			
4000Cx5, Tx5			
8000	Approval granted	Approval granted	Not approved

Table 47:

Classic Series

<table>
<tr><th>Fuel specifications

Restrictions

Series</th><th colspan="2">DIN 51603-1:2020-09
Heating oil EL standard | Heating oil EL low-sulfur
- SOLAS: Flashpoint min. 60 °C
- Cetane number min. 45 or
- Cetane index min. 42
- Lubricity max. 520 µm
- With exhaust gas aftertreatment:
• Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically.
- Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)</th><th>DIN 51603-6:2017-03
Heating oil EL alternative</th></tr>
<tr><td>099</td><td>Approval granted</td><td>Approval granted</td><td>Not approved</td></tr>
<tr><td>183</td><td>Approval granted</td><td>Approval granted</td><td>Not approved</td></tr>
<tr><td>396 C&I, Genset, Marine, Rail, Submarine</td><td>Approval granted</td><td>Approval granted</td><td>Not approved</td></tr>
<tr><td>538 Marine</td><td rowspan="2">Approval granted
Anti-wear additive necessary if sulfur content < 500 mg/kg</td><td rowspan="2">Approval granted
Anti-wear additive necessary</td><td rowspan="2">Not approved</td></tr>
<tr><td>595 Marine</td></tr>
<tr><td>956TB31, TB32, TB33
956TB34
Nuclear power station, emergency power</td><td colspan="2">Approved if:
Heating oil EL standard and low-sulfur according to DIN 51603-1 must only be used if all requirements according to Heating oil EL (→ Page 106) have been met.</td><td>Not approved</td></tr>
<tr><td>956-01 Marine / Rail</td><td rowspan="2">Approval granted
Anti-wear additive necessary if sulfur content < 500 mg/kg</td><td rowspan="2">Approval granted
Anti-wear additive necessary</td><td rowspan="2">Not approved</td></tr>
<tr><td>956-02 Marine</td></tr>
<tr><td>1163-02TB32 Genset</td><td colspan="2">Approved if:
Heating oil EL standard and low-sulfur according to DIN 51603-1 must only be used if all requirements according to Heating oil EL (→ Page 106) have been met.</td><td>Not approved</td></tr>
</table>

Fuel specifications	DIN 51603-1:2020-09		DIN 51603-6:2017-03
	Heating oil EL standard	Heating oil EL low-sulfur	Heating oil EL alternative
Restrictions	- SOLAS: Flashpoint min. 60 °C - Cetane number min. 45 or - Cetane index min. 42 - Lubricity max. 520 µm - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)		
Series			
1163-02 Marine	Approval granted Anti-wear additive necessary if sulfur content < 500 mg/kg	Approval granted Anti-wear additive necessary	Not approved
1163-03 Marine			
1163-04 Marine	Approval granted	Approval granted	Not approved

Table 48:

Two-stroke cycle engines

Fuel specifications	DIN 51603-1:2020-09		DIN 51603-6:2017-03
	Heating oil EL standard	Heating oil EL low-sulfur	Heating oil EL alternative
Restrictions	- SOLAS: Flashpoint min. 60 °C - Cetane number min. 45 or - Cetane index min. 42 - Lubricity max. 520 µm - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)		
Series			
S53, S71, S92, S149	Not approved	Not approved	Not approved

Table 49:

5.2.5 Marine distillate fuels according to ISO 8217:2018-10

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

New Series

Fuel specifications	Marine distillate fuel in accordance with DIN ISO 8217:2018-10			
	DMX	DMA	DMZ	DMB
Restrictions	To comply with SOLAS the flashpoint must be min. 60 °C. - Proportion of water: 200 mg/kg - Total contamination: max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)			
Series				
S60	Approval granted	Not approved	Not approved	Not approved
2000 Cx0, Cx1, Cx2, Cx6	Not approved	Not approved	Not approved	Not approved
2000Gx5, Gx6				
2000Mx0, Mx1, Mx2, Mx3, Mx4, Mx6	Approved if: - Sulfur content max. 500 mg/kg - Density 0.820 to 0.860 g/ml[1)] - Neutralization number: Max 0.2 mgKOH/g - Viscosity at 40 °C: 1.5 to 4.5 mm^2)/s			
2000Mx7	Not approved			
2000M41A IMO III	Not approved			
2000Px2				
2000Sx0, Sx1, Sx2, Sx6				
4000-00	Approved if: Viscosity > 4.5 mm^2/s: • Preheating required	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s^2 (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42		Not approved
4000-01				
4000-02				
4000-03C, G, P, R, S				

Fuel specifications	Marine distillate fuel in accordance with DIN ISO 8217:2018-10			
	DMX	DMA	DMZ	DMB
Restrictions	To comply with SOLAS the flashpoint must be min. 60 °C. - Proportion of water: 200 mg/kg - Total contamination: max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)			
Series				
4000M23F, M23S 4000M33F, M33S 4000M53, M53R	Approved if: - Viscosity > 4.5 mm^2/s: • Preheating required	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s^2 (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Suitable filter system is used Except for area of application of EPA Tier 2		Not approved
20V4000M53B IMO III	Approved if: - Viscosity > 4.5 mm^2/s: • Preheating required - Sulfur content max. 1000 mg/kg	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s^2 (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Suitable filter system is used Except for area of application of EPA Tier 2		Not approved
4000M63, M63L	Approved if: - Viscosity > 4.5 mm^2/s: • Preheating required	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s^2 (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Suitable filter system is used Except for area of application of EPA Tier 2 - Sulfur content max. 1000 mg/kg		Not approved
8V4000M63 IMO III	Approved if: - Viscosity > 4.5 mm^2/s: • Preheating required - Sulfur content max. 1000 mg/kg	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s^2 (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Suitable filter system is used Except for area of application of EPA Tier 2		Not approved

Fuel specifications	Marine distillate fuel in accordance with DIN ISO 8217:2018-10			
	DMX	DMA	DMZ	DMB
Restrictions	To comply with SOLAS the flashpoint must be min. 60 °C. - Proportion of water: 200 mg/kg - Total contamination: max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)			
Series				
4000M53B, M73-M93L, N43S, N83	Approved if: - Viscosity > 4.5 mm^2/s: • Preheating required	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s^2 (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Suitable filter system is used - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 Except for area of application of EPA Tier 2 - Sulfur content max. 1000 mg/kg	Not approved	
4000M73-M93L IMO III	Approved if: - Viscosity > 4.5 mm^2/s: • Preheating required - Sulfur content max. 1000 mg/kg	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s^2 (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Suitable filter system is used - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 Except for area of application of EPA Tier 2 - Sulfur content max. 1000 mg/kg		
12V4000U83	Approval granted: - CJC™ fine filter system required - Viscosity 1.5 to 4.5 mm^2/s - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42	Approval granted: - CJC™ fine filter system required - Viscosity 1.5 to 4.5 mm^2/s - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42	Not approved	

Fuel specifications	Marine distillate fuel in accordance with DIN ISO 8217:2018-10			
	DMX	DMA	DMZ	DMB
Restrictions	To comply with SOLAS the flashpoint must be min. 60 °C. - Proportion of water: 200 mg/kg - Total contamination: max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)			
Series				
4000-04 G	Approved if: - Viscosity > 4.5 mm²/s: • Preheating required	Approved if: - Viscosity > 4.5 mm²/s: • Preheating required	Approved if: - Viscosity > 4.5 mm²/s: • Preheating required	Not approved
4000-04 M	Approved if: - Viscosity > 4.5 mm²/s: • Preheating required	Not approved	Not approved	Not approved
4000-05 G	Not approved	Not approved	Not approved	Not approved
4000-05 M EPA T4	Not approved	Not approved	Not approved	Not approved
4000-05 M IMO II / IMO III	Approved if: - The limit values specified in the table “Mandatory fuel specifications (for Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected			
4000R64, R74, R84	Not approved	Not approved	Not approved	Not approved
4000R54, Tx4				
4000Cx5, Tx5				
8000	Approved if: - Viscosity > 4.5 mm²/s: • Preheating required - Sulfur content: The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) for the year of engine manufacture concerned are respected	Approved if: - Viscosity 1.5 to 4.5 mm²/s Outside the limit range between 1.5 to 4.5 mm/s² (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content: The limit values specified in the table “Mandatory fuel specifications (not applicable to Series 4000Mx5 IMO II &IMO III” (→ Page 43) for the year of engine manufacture concerned are respected		Not approved

Table 50:

[1] = Deviating values: Project-specific approval possible. If the density is too low, this can result in a power reduction. Engine operating values may change as a result of power adjustment.

Classic Series

Fuel specifications	Marine distillate fuel in accordance with DIN ISO 8217:2018-10			
	DMX	DMA	DMZ	DMB
Restrictions	To comply with SOLAS the flashpoint must be min. 60 °C. - Proportion of water: 200 mg/kg - Total contamination: max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)			
Series				
099	Approval granted	Upon request	Upon request	Not approved
183	Approval granted	Upon request	Upon request	Not approved
396 C&I, Genset, Marine, Rail, Submarine	Approved if: - Sulfur content max. 5000 mg/kg	Approved if: - Viscosity at 40 °C: 1.5 to 4.5 mm^2)/s Outside the limit range between 1.5 to 4.5 mm/s², approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 5000 mg/kg	Upon request	Not approved
538 Marine	Approved if: - Sulfur content max. 5000 mg/kg	Upon request	Upon request	Not approved
595 Marine	Approved if: - sulfur content max. 0.5% (5000 mg/kg)	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s² (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - sulfur content max. 0.5%		Not approved

Fuel specifications	Marine distillate fuel in accordance with DIN ISO 8217:2018-10			
	DMX	DMA	DMZ	DMB
Restrictions	To comply with SOLAS the flashpoint must be min. 60 °C. - Proportion of water: 200 mg/kg - Total contamination: max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)			
Series				
956TB31, TB32, TB33 956TB34 Nuclear power station, emergency power	Not approved	Not approved	Not approved	Not approved
956-01 Marine / Rail 956-02 Marine	Approved if: - Sulfur content max. 0.5% (5000 mg/kg)	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s^2 (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 0.5%		Not approved
1163-02 TB32 Genset	Not approved	Not approved	Not approved	Not approved

Fuel specifications	Marine distillate fuel in accordance with DIN ISO 8217:2018-10			
	DMX	DMA	DMZ	DMB
Restrictions	To comply with SOLAS the flashpoint must be min. 60 °C. - Proportion of water: 200 mg/kg - Total contamination: max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined series- and application-specifically. - Particle distribution for fuel according to the table “Mandatory particle limits” (→ Page 43)			
Series				
1163-02 Marine 1163-03 Marine	Approved if: - Sulfur content max. 0.5% (5000 mg/kg)	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s^2 (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - sulfur content max. 0.5%		Not approved
1163-04 Marine	Approved if: - Sulfur content max. 0.5% (5000 mg/kg)	Approved if: - Viscosity 1.5 to 4.5 mm^2/s Outside the limit range between 1.5 to 4.5 mm/s^2 (40 °C), approval following consultation with Rolls-Royce Solutions is possible, e.g. by limiting the temperature range or preheating. - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - Suitable filter system is used - Sulfur content max. 0.5%		Not approved

Table 51:

Two-stroke cycle engines

Fuel specifications	Marine distillate fuel in accordance with DIN ISO 8217:2018-10			
	DMX	DMA	DMZ	DMB
Series				
S53, S71, S92, S149	Not approved	Not approved	Not approved	Not approved

Table 52:

5.2.6 Aviation turbine fuels

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

Aviation turbine fuels

New Series

Fuel specifications Restrictions Series	F-34 / F-35 JP-8	F-44 JP-5	F-63 in accordance with DCSEA 108/A
S60	Not approved		
2000Cx0, Cx1, Cx2, Cx6	Not approved		
2000Gx5, Gx6	Not approved		
2000Mx0, Mx1, Mx2, Mx3, Mx4, Mx6, Mx7	Not approved		
2000Px2	Not approved		
2000Sx0, Sx1, Sx2, Sx6	Not approved		
4000-01	Not approved		Generally not approved, approval upon request
4000-02	Not approved		Generally not approved, approval upon request
4000-03C, G, P, R, S	Not approved		Approved for: 4000-03 G
4000M23F, M23S	Not approved	F44 AVCAT: Operation for max. 12 h, then operation with other approved fuels for min. 12 h required[1)].	Generally not approved, approval upon request
4000M33F, M33S	Not approved		Generally not approved, approval upon request
4000M53, M53R	Not approved		Generally not approved, approval upon request
4000M63, M63L	Not approved		Generally not approved, approval upon request
4000M53B, M73 - M93L	Not approved		Generally not approved, approval upon request
12V4000U83	Generally not approved, approval upon request		
4000-04 G	Not approved		Approval granted
4000-04 M	Not approved		Generally not approved, approval upon request

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Fuel specifications Restrictions Series	F-34 / F-35 JP-8	F-44 JP-5	F-63 in accordance with DCSEA 108/A
4000-05 G	Not approved		Generally not approved, approval upon request
4000-05 M EPA T4	Not approved		Generally not approved, approval upon request
4000-05 M IMO II, IMO III	Approved if: - The limit values specified in the table “Mandatory fuel specifications (for Series 4000Mx5 IMO II &IMO III” (→ Page 43) are respected		
4000R64, R74, R84	Not approved		Generally not approved, approval upon request
4000R54, Tx4	Not approved		Generally not approved, approval upon request
4000Cx5, Tx5	Not approved		Generally not approved, approval upon request
8000	Not approved		

Table 53:

[1] = Maximum accumulated runtime for the complete injection system with F44: 1500 operating hours

Classic Series

Fuel specifications Restrictions Series	F-34 / F-35 JP-8	F-44 JP-5	F-63 in accordance with DCSEA 108/A
099	Generally not approved, approval upon request		
183	Generally not approved, approval upon request		
396 C&I, Genset, Marine, Rail, Submarine	Generally not approved, approval upon request		
538 Marine	Generally not approved, approval upon request		
595 Marine			
956TB31, TB32, TB33 956TB34 Nuclear power station, emergency power	Generally not approved		
956-01 Marine / Rail	Generally not approved, approval upon request		
956-02 Marine			
1163-02 TB32 Genset	Generally not approved		

Fuel specifications Restrictions Series	F-34 / F-35 JP-8	F-44 JP-5	F-63 in accordance with DCSEA 108/A
1163-02 Marine	Generally not approved, approval upon request		Approval granted
1163-03 Marine			
1163-04 Marine	Generally not approved, approval upon request		Approval granted

Table 54:

Two-stroke cycle engines

Fuel specifications Series	F-34 / F-35 JP-8	F-44 JP-5	F-63 in accordance with DCSEA 108/A
S53, S71, S92, S149	Generally not approved		

Table 55:

5.2.7 NATO diesel fuels

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

Diesel fuel NATO Code F-54

New series

Fuel specification Restrictions Series	NATO Code F-54 in accordance with STANAG 7090 Edition 4 Approval if fuel corresponds to diesel fuel EN 590:2022-05 - Density: Min. 0.820 g/ml - Total contamination: Max. 24 mg/kg - Lubricity: Max. 520 µm Furthermore: - SOLAS: Flashpoint min. 60 °C - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)
S60	Approval issued
2000Cx0, Cx1, Cx2	Approved if: - Sulfur content max. 500 mg/kg
2000Gx5, Gx6	
2000Mx0, Mx1, Mx2, Mx3, Mx4, Mx6, Mx7	
2000Px2	
2000Sx0, Sx1, Sx2	
2000M41A IMO III	Individual case approval
2000Cx6	Approved if: - The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected
2000Sx6	
4000-00	Approval issued
4000-01	
4000-02	
4000-03 C, G, P, R, S	
4000M23F, M23S	Approval issued
4000M33F, M33S	
4000M53, M53R	
4000M63, M63L	
4000M53B, M73 - 93L, N43S, N83	Approval issued
12V4000U83	Approval issued: - CJC™ fine filter system required
4000-04 G	Approval issued
4000-04 M	Approval issued

Fuel specification Restrictions Series	NATO Code F-54 in accordance with STANAG 7090 Edition 4 Approval if fuel corresponds to diesel fuel EN 590:2022-05 - Density: Min. 0.820 g/ml - Total contamination: Max. 24 mg/kg - Lubricity: Max. 520 µm Furthermore: - SOLAS: Flashpoint min. 60 °C - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)
4000-05 G	No approval
4000-05 M EPA T4	No approval
4000-05 M IMO II, IMO III	Approved if: - The limit values specified in the table "Mandatory fuel specifications (for Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected
4000R64, R74, R84	Approved if: - The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected
4000R54, Tx4	
4000Cx5, Tx5	
8000	Approval issued

Table 56:

Diesel fuel NATO Code F-75

New series

Fuel specification	NATO Code F-75 TL 9140-0003	NATO Code F-75 STANAG 1385
Comments	- Possible power reduction due to min. density of 0.815 g/ml	- Possible power reduction and increase due to density range of 0.815 to 0.880 g/ml - Max. sulfur content 1.0% → Adjust oil and oil change interval.
Restrictions	- With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)	- Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)
Series		
S60	No approval	No approval
2000Cx0, Cx1, Cx2, Cx6	No approval	No approval
2000Gx5, Gx6		
2000Mx0, Mx1, Mx2, Mx3, Mx4, Mx6, Mx7		
2000Px2		
2000Sx0, Sx1, Sx2, Sx6		
4000-00	Approval issued	Approved if: - Cetane number min. 45 or - Cetane index min. 42
4000-01		
4000-02		
4000-03 C, G, P, R, S		
4000M23F, M23S	Approval issued	Approval issued
4000M33F, M33S		
4000M53, M53R		
4000M63, M63L		
4000M53B, M73 - 93L, N43S, N83	Approval issued	Approved if: - Cetane number min. 45 or - Cetane index min. 42
12V4000U83	Approval issued: - CJC™ fine filter system required	Approval issued: - CJC™ fine filter system required - Cetane number min. 45 or - Cetane index min. 42
4000-04 G	Approval issued	Approved if: - Cetane number min. 45 or - Cetane index min. 42

Fuel specification Comments Restrictions Series	NATO Code F-75 TL 9140-0003 - Possible power reduction due to min. density of 0.815 g/ml - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)	NATO Code F-75 STANAG 1385 - Possible power reduction and increase due to density range of 0.815 to 0.880 g/ml - Max. sulfur content 1.0% → Adjust oil and oil change interval. - Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)
4000-04 M	Approval issued	Approved if: - Cetane number min. 45 or - Cetane index min. 42
4000-05 G	No approval	No approval
4000-05 M EPA T4	No approval	No approval
4000-05 M IMO II, IMO III	Approved if: - The limit values specified in the table "Mandatory fuel specifications (for Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected	Approved if: - The limit values specified in the table "Mandatory fuel specifications (for Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected
4000R64, R74, R84	No approval	No approval
4000R54, Tx4		
4000Cx5, Tx5		
8000	Approved if: - Sulfur content: The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) for the year of engine manufacture concerned are respected	Approved if: - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content: The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) for the year of engine manufacture concerned are respected

Table 57:

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Diesel fuel NATO Code F-76

New series

Fuel specification	NATO Code F-76 STANAG 1385 Edition 6	NATO Code F-76 DEF-STAN 91-4 Issue 8	NATO Code F-76 MIL-DTL-16884N
Restrictions	- Water content: Max. 200 mg/kg - Density 0.820 to 0.860 g/ml - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)		
Series			
S60	Approval issued	Approved if:	Approval issued
2000Cx0, Cx1, Cx2, Cx6	Generally not approved, approval upon request	Generally not approved, approval upon request	Generally not approved, approval upon request
2000Gx5, Gx6			
2000Mx0, Mx1, Mx2, Mx3, Mx4, Mx6, Mx7			
2000Px2			
2000Sx0, Sx1, Sx2, Sx6			
4000-00	Approved if: - Cetane number min. 45 or - Cetane index min. 42	Approval issued	Approved if: - Cetane number min. 45 or - Cetane index min. 42
4000-01			
4000-02			
4000-03 C, G, P, R, S			
4000M23F, M23S	Approval issued	Approval issued	Approval issued
4000M33F, M33S			
4000M53, M53R			
4000M63, M63L			
4000M53B, M73 - M93L, N43S, N83	Approved if: - Cetane number min. 45 or - Cetane index min. 42	Approval issued	Approved if: - Cetane number min. 45 or - Cetane index min. 42
12V4000U83	Approval issued: - CJC™ fine filter system required - Cetane number min. 45 or - Cetane index min. 42	Approval issued: - CJC™ fine filter system required - Cetane number min. 45 or - Cetane index min. 42	Approval issued: - CJC™ fine filter system required - Cetane number min. 45 or - Cetane index min. 42
4000-04 G	Approved if: - Cetane number min. 45 or - Cetane index min. 42	Approval issued	Approved if: - Cetane number min. 45 or - Cetane index min. 42

Fuel specification Restrictions Series	NATO Code F-76 STANAG 1385 Edition 6	NATO Code F-76 DEF-STAN 91-4 Issue 8	NATO Code F-76 MIL-DTL-16884N
	- Water content: Max. 200 mg/kg - Density 0.820 to 0.860 g/ml - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)		
4000-04 M	Approved if: - Cetane number min. 45 or - Cetane index min. 42	Approval issued	Approved if: - Cetane number min. 45 or - Cetane index min. 42
4000-05 G	No approval	No approval	No approval
4000-05 M EPA T4	No approval	No approval	No approval
4000-05 M IMO II, IMO III	Approved if: - The limit values specified in the table "Mandatory fuel specifications (for Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected	Approved if: - The limit values specified in the table "Mandatory fuel specifications (for Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected	Approved if: - The limit values specified in the table "Mandatory fuel specifications (for Series 4000Mx5 IMO II and IMO III)" (→ Page 43) are respected
4000R64, R74, R84	No approval	No approval	No approval
4000R54, Tx4			
4000Cx5, Tx5			
8000	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content: The limit values specified in the table "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" (→ Page 43) for the year of engine manufacture concerned are respected		

Table 58:

NATO diesel fuels

Diesel fuels NATO Code F-54

Classic series

Fuel specification Restrictions Series	NATO Code F-54 in accordance with STANAG 7090 Edition 4 Approval if fuel corresponds to diesel fuel EN 590:2022-05 - Density: Min. 0.820 g/ml - Total contamination: Max. 24 mg/kg - Lubricity: Max. 520 µm Furthermore: - SOLAS: Flashpoint min. 60 °C - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)
099	Approval issued
183	Approval issued
396 C&I, Genset, Marine, Rail, Submarine	Approval issued
538 Marine	Approval issued Anti-wear additive necessary
595 Marine	
956TB 31, TB32, TB33 956TB34 Nuclear power station, emergency power	Approval issued Anti-wear additive necessary
956-01 Marine/Rail	Approval issued Anti-wear additive necessary
956-02 Marine	
1163-02TB32 Engine-generator set	Approval issued Anti-wear additive necessary
1163-02 Marine	Approval issued Anti-wear additive necessary
1163-03 Marine	
1163-04 Marine	Approval issued

Table 59:

Diesel fuel NATO Code F-75

Classic series

Fuel specification Comments Restrictions Series	NATO Code F-75 TL 9140-0003 - Possible power reduction due to min. density of 0.815 g/ml - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)	NATO Code F-75 STANAG 1385 - Possible power reduction and increase due to density range of 0.815 to 0.880 g/ml - Max. sulfur content 1.0% → Adjust oil and oil change interval. - Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)
099	Approval issued	Upon request
183	Approval issued	Upon request
396 C&I, Genset, Marine, Rail, Submarine	Approval issued	Upon request
538 Marine	Approval issued	Upon request
595 Marine	Approval issued	Approved if: - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 0.5% and min. 0.05%
956TB31, TB32, TB33 956TB34 Nuclear power station, emergency power	No approval	No approval
956-01 Marine/Rail	Approval issued	Approved if: - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 0.5% and min. 0.05%
956-02 Marine		
1163-02 TB32 Engine-generator set	No approval	No approval

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Fuel specification Comments Restrictions Series	NATO Code F-75 TL 9140-0003 - Possible power reduction due to min. density of 0.815 g/ml - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)	NATO Code F-75 STANAG 1385 - Possible power reduction and increase due to density range of 0.815 to 0.880 g/ml - Max. sulfur content 1.0% → Adjust oil and oil change interval. - Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)
1163-02 Marine	Approval issued	Approved if: - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 0.5% and min. 0.05%
1163-03 Marine		
1163-04 Marine	Approval issued	Approved if: - Density 0.820 to 0.860 g/ml - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 0.5%

Table 60:

Diesel fuel NATO Code F-76

Classic series

Fuel specification Restrictions Series	NATO Code F-76 STANAG 1385 Edition 6	NATO Code F-76 DEF-STAN 91-4 Issue 8	NATO Code F-76 MIL-DTL-16884N
	- Water content: Max. 200 mg/kg - Density 0.820 to 0.860 g/ml - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)		
099	Approval issued	Approved if:	Approval issued
183	Approval issued	Approved if:	Approval issued
396 C&I, Genset, Marine, Rail, Submarine	Upon request	Approved if:	Upon request
538 Marine	Upon request	Approval issued	Upon request

Fuel specification	NATO Code F-76 STANAG 1385 Edition 6	NATO Code F-76 DEF-STAN 91-4 Issue 8	NATO Code F-76 MIL-DTL-16884N
Restrictions	- Water content: Max. 200 mg/kg - Density 0.820 to 0.860 g/ml - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)		
Series			
595 Marine	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 0.5% Anti-wear additive necessary if sulfur content < 500 mg/kg	Approved if: Anti-wear additive necessary if sulfur content < 500 mg/kg	Approved if: - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg
956TB31, TB32, TB33 956TB34 Nuclear power station, emergency power	No approval	No approval	No approval
956-01 Marine/Rail 956-02 Marine	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 0.5% Anti-wear additive necessary if sulfur content < 500 mg/kg	Approved if: Anti-wear additive necessary if sulfur content < 500 mg/kg	Approved if: - Cetane number min. 45 or - Cetane index min. 42 Anti-wear additive necessary if sulfur content < 500 mg/kg
1163-02 TB32 Engine-generator set	No approval	No approval	No approval
1163-02 Marine 1163-03 Marine	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 0.5% Anti-wear additive necessary if sulfur content < 500 mg/kg	Approved if: - Sulfur content max. 0.5%	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 0.5% Anti-wear additive necessary if sulfur content < 500 mg/kg
1163-04 Marine	Approved if: - Cetane number min. 45 or - Cetane index min. 42 - Sulfur content max. 0.5%	Approval issued:	Approved if: - Cetane number min. 45 or - Cetane index min. 42

Table 61:

– Other qualities on request

NATO diesel fuels

Diesel fuel NATO Code F-54

Two-stroke cycle engines

Fuel specification Restrictions Series	NATO Code F-54 in accordance with STANAG 7090 Edition 4 Approval if fuel corresponds to diesel fuel EN 590:2022-05 - Density: Min. 0.820 g/ml - Total contamination: Max. 24 mg/kg - Lubricity: Max. 520 µm Furthermore: - SOLAS: Flashpoint min. 60 °C - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application. - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)
S53, S71, S92, S149	Approved if lubricity max. 460 µm

Table 62:

Diesel fuel NATO Code F-75

Two-stroke cycle engines

Fuel specification Comments Restrictions Series	NATO Code F-75 TL 9140-0003 - Possible power reduction due to min. density of 0.815 g/ml - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)	NATO Code F-75 STANAG 1385 - Possible power reduction and increase due to density range of 0.815 to 0.880 g/ml - Max. sulfur content 1.0% → Adjust oil and oil change interval - Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)
S53, S71, S92, S149	No approval	No approval

Table 63:

Diesel fuel NATO Code F-76

Two-stroke cycle engines

Fuel specification	NATO Code F-76 STANAG 1385 Edition 6	NATO Code F-76 DEF-STAN 91-4 Issue 8	NATO Code F-76 MIL-DTL-16884N
Restrictions	- Water content: Max. 200 mg/kg - Total contamination: Max. 24 mg/kg - With exhaust gas aftertreatment: • Max. sulfur content of 15 mg/kg, or is defined specific to the series and application - Particle distribution for fuel according to the "Mandatory particle limits" table (→ Page 43)		
Series			
S53, S71, S92, S149	No approval	No approval	No approval

Table 64:

– Other qualities on request

5.2.8 Paraffinic diesel fuel in accordance with EN 15940

Standards define paraffinic diesel fuels as being fuels produced by synthesis or hydrogenation processes. They are specified in the EN 15940 standard.

Synthesis

In this case, the term synthesis is used to denote the Fischer-Tropsch reaction. These fuels are therefore also often referred to as Fischer-Tropsch fuels or XtL (X to liquid), with "X" standing for the type of initial feedstock. Such fuels are produced by first generating a mixture of carbon monoxide and hydrogen, referred to as synthesis gas, from the initial feedstock. This is then used to create the paraffinic fuel via Fischer-Tropsch synthesis by means of chain growth.

Hydrogenation

Hydrogenation is the chemical reaction of the feedstock with hydrogen. The initial feedstock used is vegetable oils/waste fats and waste materials containing oil that are not in competition with foodstuff production. This fuel is marketed as an HVO = hydrotreated vegetable oil.

Depending on the initial feedstock, paraffinic fuels are designated, for example, as follows:
- HVO = hydrotreated vegetable oil, initial feedstock: Biomass
- GtL = gas to liquid, initial feedstock: Natural gas, biogas
- BtL = biomass to liquid, initial feedstock: Biomass

As a result of the production process, paraffinic fuels consist almost entirely of linear or branched hydrocarbon chains, known as alkanes. They do not contain any sulfur and are almost free of aromatics. Due to their chemical composition, paraffinic fuels have different properties to fossil diesel fuels in terms of higher ignitability and lower density. The result is an overall reduction in untreated emissions.

EN 590 specifies that fatty acid methyl ester (FAME as per EN 14214) can be blended into paraffinic diesel fuel as per EN 15940 by up to 7% by volume.

Paraffinic diesel fuels are specified in ASTM D975 (Grade 1-D and Grade 2-D, S15) in the U.S., just like fossil diesel fuels. This is possible as this standard does not specify any limit value for density, in contrast to EN 590. These paraffinic diesel fuels can also be used provided that they comply with the fuel specifications listed in table (→ Page 95). In the U.S., paraffinic diesel fuels are often referred to as "R99" fuels or "renewables".

The quality of the fuel is very important for satisfactory engine performance, long engine service life and acceptable exhaust emission levels. For this reason, the paraffinic fuels must observe the following fuel specifications.

Mandatory 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
Density at 15 °C	Min.	D1298 D4052	EN ISO 3675 EN ISO 12185	0.765 g/ml[1)]
	Max.			0.860 g/ml
API gravity at 60 °F	Min.	D287 D4052		53
	Max.			33

		Test methods		Limit values
		ASTM		
Viscosity at 40 °C	Min.	D445	EN ISO 3104	1.5 mm²/s
	Max.			4.5 mm²/s
Flashpoint (closed crucible)	Min.	D93	DIN EN ISO 27 19	55 °C (60 °C for SOLAS)[2)]
Boiling curve:		D86	EN 17306	
– Initial boiling point				160 to 220 °C
– Volume share 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: – Engines without exhaust gas aftertreatment and without exhaust gas recirculation	Max.	D482	EN ISO 6245	0.01% by weight (100 mg/kg)
Sulfur content	Max.	D5453 D2622	EN ISO 20848 EN ISO 20884	0.0015% by weight (15 mg/kg)[3)]
Cetane number	Min. Max.	D613	EN ISO 5165 EN ISO 15195	45 80[4)]
Cetane index	Min.	D976	EN ISO 4264	42
Copper corrosion 3 h at 50 °C	Max. degree of corrosion	D130	EN ISO 2160	1a
Oxidation stability (Rancimat)[5)]	Min.		EN 15751	20 hours
Oxidation stability[6)]	Max.	D2274	EN ISO 12205	25 g/m³
Lubricity at 60 °C (HFRR value)	Max.	D6079	EN ISO 12156-1	400 µm
Neutralization number	Max.	D974		0.2 mg KOH/g
Microbial contamination				Inadmissible

Table 65:

[1)] = May result in reduced power on engines featuring unit-pump injection systems (PLD).

[2)] = For marine applications, a min. flashpoint of 60 °C (SOLAS = safety of life at sea) applies.

[3)] = Note: 1% by weight = 10,000 mg/kg = 10,000 ppm.

[4)] = Higher cetane number possible upon request from Rolls-Royce Solutions GmbH.

[5)] = Relevant for diesel fuel with FAME content of ≥ 2% by volume

[6)] = Relevant for diesel fuel with FAME content of < 2% by volume

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Compliance with the requirements stipulated in the tables "Cylinder head TBO" and "Series-related injection and exhaust gas aftertreatment (EGAT) systems" (→ Page 43) is mandatory with regard to winter operation and purity requirements for the diesel fuel.

Approvals for paraffinic diesel fuels

Paraffinic diesel fuels as per EN 15940 or ASTM D975 (Grade 1-D and Grade 2-D, S15) have been approved for the following series, provided that they comply with the characteristic values specified in table (→ Table 66):

Engine		Safety[1]	Emission stage[2]				Comments
Series	Application		Non-cert	EPA	EU	IMO	
1163	Mx4	X					
1600	Gx0	X	X	T2, T3	IIIA		EPA T3: Only 10V1600G70S EU IIIA: Only 10 V engines
1600	Gx1	X	X	T2			
2000	Mx0, Mx1	X*	X*	T2*/**		T2*	* = Approx. 5% reduced power rating ** = Compliant[3]
2000	Mx2, Mx3, Mx4	X	X	T2		T2	
2000	Mx6	X		T3c T3r	***	T2	T3c: EPA Tier 3 for commercial use T3r: EPA Tier 3 for recreational use *** = EU Recr. Craft Dir. 2013/53/EU and UK
2000	Mx7	X		T3r		T2, T3	T3r: EPA Tier 3 for recreational use
4000	Gx1 Gx2	X	X	T1			
4000	Gx3 Gx4	X	X	T2			
4000	Mx0, Mx1	X	X	T2	ZKR2 ****	T1 T2	**** = Central Commission for the Navigation of the Rhine
4000	Mx3	X	X	T2	IIIA ZKR2 ****	T2	EU IIIA: M53x/M63x only **** = Central Commission for the Navigation of the Rhine: M23x/M33x only
4000	Mx4	X	X	T3	IIIA	T2	EU IIIA: M54R only
4000	Mx5	X	X	T4		T2 T3	
4000	Px3	X	X	T2		T2	
4000	Cx1 Cx2	X	X	T1**			** = Compliant[3]
4000	Cx3	X	X	T2**			** = Compliant[3]
4000	Cx5	X	X	T4	V		
4000	Sx1	X	X	T1**			
4000	Sx3	X	X	T2**			** = Compliant[3]
4000	Tx4	X	X	T4i**			** = Compliant[3]
4000	Tx5	X	X	T4			
4000	Rx1	X	X[4]				
4000	Rx3	X	X[4]		IIIA		

Engine		Safety[1]	Emission stage[2]				Comments
Series	Appli-cation		Non-cert	EPA	EU	IMO	
4000	Rx4	X			IIIB, V		
8000	Mx1	X	X			T2	

Table 66:

[1] = The product safety of the engine in terms of danger to life and limb is guaranteed with the use of these fuels.

[2] = When using an EN 15940-compliant fuel or a fuel in accordance with ASTM D975 that meets the fuel specifications to be complied with in accordance with (→ Page 95), the respective legal requirements are met.

[3] = Compliant: Respects emissions limits, no certificate available.

[4] = Includes approval for UIC engines (IRS60623/IRS60624), EN 15940 does not meet the requirements of the UIC reference fuel.

Important

Further project-specific approvals are possible upon request from Rolls-Royce Solutions.

Effects of paraffinic diesel fuels on elastomer components

Paraffinic diesel fuels are compatible with conventional elastomer materials such as NBR (nitrile butadiene rubber) or FKM (fluoro-rubber). Because they are free of aromatics, they are less susceptible to swelling (especially NBR gaskets) compared to fossil diesel fuels that contain aromatics. For this reason, the possibility of leakages when transitioning from fossil diesel fuels to paraffinic diesel fuels cannot be completely ruled out.

Procedure for changing over from fossil to paraffinic diesel fuels:

A change-over is possible without any problems. Rolls-Royce Solutions recommends regular checks of the gaskets for leakages in the first four weeks after switching to paraffinic diesel fuel.

Notes on operation with water separators

Paraffinic diesel fuel has a greater tendency to discharge free water into water separators compared with conventional fossil diesel fuel. Slightly higher water discharge in water separators in comparison with fossil diesel fuel is normal.

Blending paraffinic diesel fuels with conventional fossil diesel fuels:

Paraffinic diesel fuels are known as "drop-in" diesel fuels.

This means that the end customer can mix paraffinic diesel fuel with conventional fossil diesel fuels in any ratio without having to make any adjustments to the engine or fuel system.

This also means that the end customer can fill up with both paraffinic and conventional fossil diesel fuels according to the tables "Mandatory fuel specifications (no applicability to Series 4000Mx5 IMO II and IMO III)" and "Mandatory fuel specifications for Series 4000Mx5 IMO II and IMO III" (→ Page 43) without having to empty/clean the tank first.

"Premium diesel fuels" which comply with EN 590 and also reduce CO_2 emissions by around 20% are also available on the market. Paraffinic diesel fuel in accordance with EN 15940 is already added to these fuels at the manufacturer's facility. The amount of paraffinic diesel fuel added, however, is only high enough to ensure observance of the required minimum density limit value specified in EN 590.

Notes on operation with exhaust gas aftertreatment systems

Observe comments from the chapter on "Diesel fuels for engines with exhaust gas aftertreatment (AGAT)" (→ Page 107) "Diesel fuels for engines with exhaust gas aftertreatment" table.

5.2.9 Biodiesel and biodiesel mixtures

General notes and information

- The standardized general term "FAME" (fatty acid methyl ester) is used in this document for biodiesel fuel. Pure FAME fuel is also designated as B100.
- Biodiesel mixtures consist of FAME fuels that are mixed with fossil diesel fuel. For instance, B30 denotes a mixture comprising 30% by volume of FAME and 70% by volume of fuel based on crude oil/mineral oil. The use of biodiesel mixtures may have negative effects in terms of engine power, service and maintenance requirements, emissions and useful life.
- Operators of mtu engines therefore need to be clear about the effects that FAME may have on their engines, and must take all of the necessary measures to ensure the reliability and safety of their engines. This chapter provides Rolls-Royce Solutions customers with important information on the use of biodiesel mixtures in mtu engines and explains the potential impact these fuels may have on the Rolls-Royce Solutions warranty. Please read this information carefully before using biodiesel mixtures in mtu engines.
- Statements on pure FAME also apply to biodiesel mixtures, but the effects may be mitigated if biodiesel mixtures are used.
- We can make no comment with regard to the level of FAME resistance of the fuel system, which is not part of our scope of supply.
- FAME is an extremely effective solvent. Prevent FAME or biodiesel mixtures from coming into contact with varnished surfaces to avoid damaging and stripping the varnish.
- FAME is not compatible with all materials. Certain elastomers (including NBR, rubber) are chemically attacked, leakages are likely.
- Materials containing zinc and copper accelerate the aging (oxidation) of the fuel, and thus lead to deposit formation, corrosion and shortened filter service lives.
- Use a suitable tank and line system:
  - Ensure that the system can be filled up to the fill line.
  - Minimize the entry of atmospheric oxygen through the tank vent in the event of temperature fluctuations, etc. (e.g. by installing a pressure relief valve and filter; contact your tank supplier to do this).
  - For this, see also A060631 "Useful information on fuels, tank systems and filtration"
  - It is recommended to use a tank vent with humidity separator.
- The characteristic smell of FAME exhaust gases, especially during long periods of idling, may be perceived as unpleasant. The nuisance caused by smell can be reduced by the use of an oxidation catalyst, which may be installed by the vehicle/equipment manufacturers at their own risk.
- Furthermore, always ensure that the current version of the series-specific fluids and lubricants specifications is available and its contents are observed.
- More extensive preventative measures are additionally required for some applications. Our Customer Support department is available to answer any questions you may have on this topic.

Important

The warranty from Rolls-Royce Solutions does not cover defects caused by the use of FAME fuels with more than 7% FAME by volume, in particular when using FAME of inferior quality or in the event of non-compliance with our regulations for FAME operation. This also applies to any claims for damages, regardless of the legal grounds and whether direct or indirect, immediate or not immediate.

Important

The use of diesel fuel with an FAME content of max. 7% (e.g. in compliance with EN 590:2022) is unproblematic. Such fuel may also be used in engines which have not been approved for operation with FAME, without affecting oil drain intervals.

Important

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

Effects of B100 and biodiesel mixtures on engines

The properties of FAME differ from those of fossil and paraffinic diesel fuels. Some of these properties can have a negative effect on engines. The possible effects are explained below.

Important: THESE EFFECTS ARE NOT FAULTS CAUSED BY THE ENGINE MANUFACTURER OR THAT THE MANUFACTURER IS RESPONSIBLE FOR. THEY ARE THEREFORE EXCLUDED FROM THE ROLLS-ROYCE SOLUTIONS WARRANTY. ROLLS-ROYCE SOLUTIONS SHALL NOT ASSUME ANY LIABILITY FOR COSTS OWING TO THE EFFECTS DESCRIBED BELOW.

- FAME is a solvent. After switching over to B100 or a biodiesel mixture, contamination and certain deposits may become loose in the tank and lines, causing the fuel filter to be subjected to an increased accumulation of these. Filter change intervals must be adjusted accordingly.
- At low temperatures, FAME becomes thicker (increase in viscosity). The use of biodiesel and biodiesel mixtures at low temperatures may therefore cause the fuel filters to become blocked. Install a fuel preheating system if the engine is operated at temperatures below 0 °C (32 °F). This can reduce the negative effect on the fuel supply.
- Compared to conventional diesel fuels according to these fluids and lubricants specifications, FAME has a higher water solubility, meaning that a higher proportion of water should be expected depending on the fuel temperature. This can lead to increased corrosion and faster microbe growth in the fuel system. Due to the higher proportion of water dissolved in B100 or in a biodiesel mixture, reduced water separator performance must be expected, as water separators are primarily for separating free water.
- For systems without a water separator: Retrofit a water separator to reduce the risk of microbe growth and corrosion in the fuel system.
- Regular maintenance of the water separator is mandatory. Separated water must be drained off daily, depending on the water quantity.
- FAME is a natural product and therefore subject to natural aging processes. The consequences of aging are the formation of acids and/or polymers that lead to deposits.
- The formation of acid can lead to corrosion of fuel-carrying components.
- The formation of deposits may cause components to become "sticky", which potentially restricts their movement.
  - For this, see also section (→ Page 102)→ Effects of B100 and biodiesel mixtures on prolonged engine standstills, temporary shutdown, seasonal use, use in standby gensets
- The formation of deposits may have an adverse effect on the interaction of components inside the unit. This results in an increased risk of components failing, and even the breakdown of entire cylinders. The high operating temperatures in the surroundings encourage the formation of mineral deposits, other deposits and encrustations which may render the valve unable to correctly regulate the fuel supply. This means that it is no longer possible for the quantity of fuel required at full load to be injected into the engine, thereby reducing the maximum engine power.
- FAME contains chemical components which can interact with the sensors in the exhaust gas recirculation system in such a way that incorrect data is reported to the engine control system. This can have consequences such as engine operation being adapted to the wrong values and emissions therefore no longer complying with the applicable provisions.

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Effects of B100 and biodiesel mixtures on exhaust gas aftertreatment systems

- On engines with exhaust gas aftertreatment systems, the functioning of the catalytic converter may be impaired as biodiesel mixtures can contain a higher proportion of trace elements (e.g. alkaline metals, alkaline earth metals and phosphorus) than conventional diesel fuels according to these fluids and lubricants specifications.
- The above-mentioned trace elements may also result in excess ash formation and accumulations in the soot filters and poisoning of the catalytic converters. Excess ash formation results in a constantly rising exhaust back pressure and can therefore cause a slow reduction in engine power.
- Furthermore, legally prescribed technologies for checking emissions on these engines (e.g. NOx monitoring diagnostics) lead to a significant decrease in engine power.
- This means that the legally prescribed emissions limits are not complied with and the operating license becomes invalid.
- Due to the properties of FAME fuels, hydrocarbons may be deposited in the exhaust gas aftertreatment system during prolonged idling/low-load operation. These stored hydrocarbons may subsequently ignite. This can lead to greatly increased surface temperatures and a sharp rise in exhaust gas temperatures, with corresponding effects on neighboring and downstream components. The full functionality of the exhaust gas aftertreatment system cannot be guaranteed.

Important

Please note that the previous statements in this chapter (→ Page 99) refer exclusively to engines with EXHAUST GAS AFTERTREATMENT SYSTEMS (EGAT systems), which were purchased as a fully integrated system from Rolls-Royce Solutions. When using an exhaust gas aftertreatment system purchased from a third party, the fully integrated system (engine and exhaust gas aftertreatment system) must be approved separately by the third-party provider.

Effects of B100 and biodiesel mixtures on engine oil

- On all engines, lubricating the piston skirts with oil leads to a small amount of fuel entering the engine oil. This is generally of little importance with conventional diesel fuels in accordance with these fluids and lubricants specifications, since the fuel evaporates quickly upon reaching the operating temperature. Its high boiling point means that FAME does not evaporate but remains in the engine oil in its entirety. Aging of the FAME can therefore cause residues to form, cause oil filters to become blocked and ultimately cause the engine to come to a stop, resulting in significantly shorter oil change intervals. Under certain conditions, chemical reactions may take place between FAME and the engine oil. This can lead to engine damage.
- For this reason, high-quality engine oil must be used. Operating the engine with low-quality category 1 oil leads to a more rapid deterioration in oil quality when using fuels containing FAME. For this reason, we recommend using oil of oil category 2 or higher. The approved engine oils can be found in the series-specific fluids and lubricants specifications.
- When using B100 and biodiesel mixtures, the change intervals for engine oil and oil filters must be shortened.
- With biodiesel mixtures (with a maximum FAME content of 30%), the change intervals for engine oil and filters must be halved in comparison to the intervals stated in these fluids and lubricants specifications.
- When using B100, even shorter change intervals for engine oil and oil filters are to be expected.
- In addition to changing the oil and filters on time, the engine oil and filters must be analyzed regularly in order to ensure that the oil quality is correct. Interval: Every 100 operating hours or every three months, depending on which comes first. A decision must be made as to whether to further adjust the change intervals on the basis of the results.

Important

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

Procedure for switching from fossil diesel fuel to B100 or biodiesel mixtures

- Before using FAME-containing fuels (with an FAME content of more than 7%), the engine oil, the oil filter and all fuel filters must be changed.
- After switching to a biodiesel mixture with a maximum FAME content of 30%:
  - Change all fuel filters after 50 operating hours at the latest.
- After switching to a biodiesel mixture with an FAME content of more than 30% (including B100):
  - Change all fuel filters, the engine oil and the engine oil filters after approx. 25 operating hours.

Effects of B100 and biodiesel mixtures on maintenance

The maintenance activities defined in the maintenance schedules must be adhered to. In addition, the following additional maintenance activities and requirements must be observed in order to ensure the quality and availability of your engine:

- When using B100 and biodiesel mixtures, the change intervals for fuel filters must be shortened:
  - When using biodiesel mixtures with an FAME content of more than 7% up to a maximum of 30%, the fuel filters and fuel prefilters must be replaced every 250 operating hours.
  - When using a biodiesel mixture with an FAME content of more than 30% (including B100), the fuel filter must be replaced every time the engine oil is changed.
  - These change intervals can also be further reduced over a prolonged period of time. Depending on how many old deposits are removed from the fuel system by the FAME and flushed into the fuel filters.
- When using biodiesel mixtures with an FAME content of more than 7% up to a maximum of 30%, the following additional recommendations regarding maintenance must be followed:
  - The component TBO of the LP fuel pump, of the O-rings in the LP fuel system and of the valves in the fuel filter head is shortened to TBO/3.
- There has been no experience with the use of biodiesel mixtures with an FAME content of more than 30%. A further shortening of the component TBO is possible.

Effects of B100 and biodiesel mixtures on engine power and fuel consumption

- Compared to conventional diesel fuels according to these fluids and lubricants specifications, FAME has a lower energy density.
- Due to the calorific value, the engine power is reduced by approx. 10% when using B100. This leads to a corresponding increase in fuel consumption as compared to operation with diesel fuel. Engine power corrections are not permissible.
- Operating the engine with B20 results in a power reduction of approximately 2% and an increase in fuel consumption of around 3%.

Effects of B100 and biodiesel mixtures on prolonged engine standstills, temporary shutdown, seasonal use, use in standby gensets

- On engines with long downtimes, the formation of deposits (components become "sticky", movement of these components may be restricted) can result in a situation where the engine can no longer be started.

Important

Rolls-Royce Solutions shall accept no liability in the event that the engine in a standby genset cannot be started as a result of the formation of deposits!

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- Corrosion damage to fuel-carrying components is possible due to aging (oxidation) of the fuel.
- For these reasons, prolonged engine standstills and temporary shutdowns should be avoided.
- The following periods are to be understood as prolonged engine standstills:
  - For larger than B7 to B20: More than one week
  - For larger than B20 to B35: More than three days
  - For larger than B35 to B100: More than one day
- For all engines where the engine standstills defined above occur between uses, the fuel system must be flushed with pure, FAME-free, high-quality diesel fuel in accordance with the applicable series-specific fluids and lubricants specifications before the engine is decommissioned.
- All engines used in fire-fighting pumps, fire-extinguishing equipment or police equipment must be thoroughly flushed with pure, FAME-free, high-quality diesel fuel in accordance with the applicable series-specific fluids and lubricants specifications each time they are operated with a biodiesel mixture.
- When flushing, you must ensure that no biodiesel components remain in the fuel system.

Biodiesel B100 according to EN 14214, ASTM D6751 and SNI 71825

- The FAME must comply with EN 14214:2012+A2:2019, ASTM D6751 (2024) and SNI 71825. Operation with fuels of lower quality can lead to damage and malfunctions.
- Either FAME or diesel fuel can be used. The various mixtures of FAME and fossil diesel fuel, which may occur in the fuel tank as a result, present no problems.

Biodiesel mixtures up to a maximum FAME content of 30%

- Biodiesel mixtures consist of FAME fuels that are mixed with fossil diesel fuel. For instance, B30 denotes a mixture comprising 30% FAME and 70% fuel based on crude oil/mineral oil. mtu engines were not specially designed to be operated with biodiesel mixtures.
- The following standards for biodiesel mixtures were assessed:
  1. 3675.K/24/DJM (standard for diesel fuel with 10% FAME content, i.e. B10, in Indonesia)
  2. 28.K/10/DJM.T (standard for diesel fuel with 20% FAME content, i.e. B20, in Indonesia)
  3. 0234.K/10/DJM.S/2019 (standard for diesel fuel with 30% FAME content, i.e. B30, in Indonesia)
  4. EN 16734:2022 (European standard for diesel fuel with 10% FAME content, i.e. B10)
  5. EN 16709:2015+A1:2018 (European standard for diesel fuel with 20% and 30% FAME content, i.e. B20 and B30)
  6. ASTM D7467 (2023) (U.S. standard for diesel fuel with 6% to 20% FAME content, i.e. B6–B20)
- The following requirements must be complied with here:
  1. The B100 used for mixing complies with the specifications EN 14214:2012+A2:2019, ASTM D6751 (2024) or SNI 71825
  2. The distilled diesel fuel used for mixing complies with the specifications approved in this version of the fluids and lubricants specifications. The restrictions specified there must also be complied with.

Approvals for biodiesel greater than B7 to B100 are pure safety approvals, i.e. the product safety of the engine in terms of danger to life and limb is guaranteed with the use of these fuels. This does not include emissions approval. The safety approval applies to the following series/model types/applications, taking into account the measures listed in this chapter (→ Page 99).

Diesel engines approved for the use of fuels with FAME

Series	Application/model type	Safety approval[1)]	Comments
1163	Mx4	x	All years of manufacture
1600	Gx0	x	All years of manufacture
1600	Gx1	x	All years of manufacture
2000	Cx6	x	All years of manufacture
2000	Gx2	x	All years of manufacture
2000	Gx3	x	With metal low-pressure fuel lines
2000	Gx4	x	All years of manufacture
2000	Gx5	x	All years of manufacture

Series	Application/model type	Safety approval[1)]	Comments
2000	Sx6	x	All years of manufacture
4000	Cx0	x	All years of manufacture
4000	Cx1	x	All years of manufacture
4000	Cx2	x	All years of manufacture
4000	Cx3	x	All years of manufacture
4000	Cx5	x	All years of manufacture
4000	Gx1	x	With metal low-pressure fuel lines
4000	Gx2	x	All years of manufacture
4000	Gx3	x	All years of manufacture
4000	Gx4	x	All years of manufacture
4000	Mx0	x	All years of manufacture
4000	Mx1	x	All years of manufacture
4000	Mx3	x	All years of manufacture
4000	Mx4	x	All years of manufacture
4000	Mx5	x	All years of manufacture
4000	Px1	x	All years of manufacture
4000	Px3	x	All years of manufacture
4000	Rx1	x	All years of manufacture
4000	Rx3	x	From year of manufacture 2020 onward/only with rest-of-world fuel filter configuration
4000	Rx4	x	All years of manufacture
4000	Sx1	x	All years of manufacture
4000	Sx3	x	All years of manufacture
4000	Tx4	x	All years of manufacture
4000	Tx5	x	All years of manufacture
8000	Mx1	x	All years of manufacture

Table 67:

[1)] = The product safety of the engine in terms of danger to life and limb is guaranteed with the use of these fuels.

Important

Engines that are not listed in the table above are not suitable for operation with fuels with an FAME content of more than 7%, i.e. no safety approval has been granted. Further project-specific approvals are possible upon request from Rolls-Royce Solutions GmbH.

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5.2.10 Pure vegetable oil

Vegetable oils as an alternative to diesel fuel

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

5.2.11 Heating oil EL

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

– Cetane number

– Sulfur content

– Oxidation stability

– Corrosion effect on copper

– Lubricity

– Low temperature behavior

If the heating requirements comply with the specifications of the diesel fuel EN 590:2022-05 (summer and winter quality), there are no technical reasons why it can not be used in the diesel engine

5.3 Diesel fuels for engines with exhaust gas aftertreatment (EGAT)

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

Depending on the technology used for exhaust gas aftertreatment, the following fuels can be used:

Exhaust gas technology	Technical approval for						
	EN 590:2022-05	ASTM D975-19 Grade 1-D	ASTM D975-19 Grade 2-D	DMX in accordance with DIN ISO 8217:2018-10	DMA in accordance with DIN ISO 8217:2018-10	Heating oil EL low-sulfur in accordance with DIN 51603:2020-09	Paraffinic fuels according to EN 15940 and ASTM D975 (Grade 1-D and 2-D, S15)
Restrictions:							
Diesel oxidation catalyst DOC (without particulate filter)	No restriction	S15	S15	No approval	No approval	No approval	No restriction
Particle oxidation catalyst (POC)	Ash < 10 mg/kg	S15 Ash < 10 mg/kg	S15 Ash < 10 mg/kg	No approval	No approval	No approval	Individual case approval
SCR system with vanadium catalysts (no particulate filter)	Series 4000-M05 EPA T4 → no approval	S15 S < 500 mg/kg with individual case approval Series 4000-M05 EPA T4 → no approval Series 4000-M03/M05 IMO III → S < 1000 mg/kg	S15 S < 500 mg/kg with individual case approval Series 4000-M05 EPA T4 → no approval Series 4000-M03/M05 IMO III → S < 1000 mg/kg	Individual case approval Series 4000-M05 EPA T4 → no approval Series 4000-M03/M05 IMO III → S < 1000 mg/kg		Series 4000-M05 EPA T4 → no approval Series 4000-M03/M05 IMO III → S < 1000 mg/kg	No restriction
SCR system with zeolite catalysts (no particulate filter)	No restriction	S15 Series 4000-M03 IMO III → S < 1000 mg/kg	S15 Series 4000-M03 IMO III → S < 1000 mg/kg	No approval Series 4000-M05 EPA T4 → no approval Series 4000-M03 IMO III → S < 1000 mg/kg	No approval Series 4000-M05 EPA T4 → no approval Series 4000-M03 IMO III → S < 1000 mg/kg	No approval Series 4000-M05 EPA T4 → no approval Series 4000-M03 IMO III → S < 1000 mg/kg	No restriction

Exhaust gas technology	Technical approval for						
	EN 590:2022-05	ASTM D975-19 Grade 1-D	ASTM D975-19 Grade 2-D	DMX in accordance with DIN ISO 8217:2018-10	DMA in accordance with DIN ISO 8217:2018-10	Heating oil EL low-sulfur in accordance with DIN 51603:2020-09	Paraffinic fuels according to EN 15940 and ASTM D975 (Grade 1-D and 2-D, S15)
Diesel particulate filter (DPF)	Ash < 10 mg/kg	S15 Ash < 10 mg/kg	S15 Ash < 10 mg/kg	Individual case approval		No approval	No restriction for diesel particulate filters regarding compliance with mass-based limit values Individual case approval required for diesel particulate filters regarding compliance with number-based limit values
Combination system SCR+ particulate filter	Ash < 10 mg/kg	S15 Ash < 10 mg/kg	S15 Ash < 10 mg/kg	Individual case approval		No approval	No restriction for diesel particulate filters regarding compliance with mass-based limit values Individual case approval required for diesel particulate filters regarding compliance with number-based limit values

Table 68: Diesel fuels for engines with exhaust gas aftertreatment

If the specifications in the tables are not observed, the specified TBO cannot be guaranteed.

Warranty cases that result from the use of an impermissible fuel quality shall be rejected.

If a fuel is present that does not comply with the specifications, Rolls-Royce Solutions can assist in the selection of appropriate improvement measures in certain circumstances.

Any existing restrictions based on engine requirements must also be observed.

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Important

Use of diesel fuel with a percentage of biodiesel (FAME, fatty acid methyl ester) of max. 7% in accordance with EN 590:2022-05 is unproblematic. The use of fuels with an increased percentage of biodiesel is not permitted for plants with exhaust gas aftertreatment, because trace elements they may contain can act as catalyst poisons and lead to filter obstructions.

Important

The use of paraffinic fuels generally has a positive influence on the engine's particulate emissions. However, this can have a negative impact on the filtration efficiency of a diesel particulate filter (DPF), particularly with regard to the number of particles. Project-specific approvals are possible upon request from Rolls-Royce Solutions. For information on the approval status of individual series, see (→ Page 95), table on "Approvals for paraffinic diesel fuels".

Important

Commercially available diesel fuels normally contain considerably fewer ash-forming agents than those certified by the relevant standards (typical ash content max. 0.001% = 10 mg/kg). The particulate filters are designed accordingly for these low loads, 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.

Use of fuel additives for lowering the soot regeneration temperature on plants with particulate filters

Fuel additives for lowering the soot regeneration temperature (FBC, fuel borne catalyst) are generally not approved. The exhaust gas aftertreatment systems from Rolls-Royce Solutions are designed such that soot regeneration takes place without additives.

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5.4 Fuel additives

Fuel additives

The engines are designed such that optimal 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.

If additives containing metal are added (that contain e.g. ferrocene, cerium, etc.) with the intention of improving the operating behavior of the engine system and the regeneration behavior of diesel particulate filters, it should be noted that the metal-based additives lead to significantly increased ash formation. This ash covers the active surface of the particulate filters and restricts their functionality. It can also lead to wear in the engine.

The increased formation of additive ash and its negative consequences are particularly critical for emissions-optimized engines with diesel particulate filters.

In any case, it drastically shortens the approved maintenance and cleaning intervals of the diesel particulate filter.

For this reason, the subsequent addition of metal-containing additives to the fuels approved by Rolls-Royce Solutions is not permitted or approved.

Diesel fuels with metal-containing additives are also offered on the market under the EN 590 specification. In this case, the fuels are labeled accordingly as per the EN 590 regulations.

You should also refrain from using fuels labeled like this. Ultimately, they also lead to the phenomena and effects mentioned above.

The anti-wear additives (→ Page 111), biocides (→ Page 111) and cleaning additives are exceptions.

Important
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. Prior to using a fuel additive approved by Rolls-Royce Solutions, the operating company must additionally obtain approval for the use of this additive from the fuel manufacturer, in order to exclude the possibility of any incompatibilities of the additive with the fuel or additives already contained in the fuel from the time of production. Additives must not contain inorganic substances because they can cause damage to the engine and the exhaust gas aftertreatment system.

Diesel fuels with sulfur content < 500 mg/kg

Excessive valve seat wear occurs on engine series featuring cylinder heads without valve seat inserts (both inlet and exhaust valves) when low-sulfur fuel grades are used (sulfur content < 500 mg/kg). This applies to the following engine series:

Series	Use of additives
331 up to year of manufacture 1969	Yes*
362	Yes*
396 up to year of manufacture 1975	Yes*
493	Yes*
538	Yes
595	Yes
652	Yes*
956	Yes
1163 up to model type 01-03	Yes*

Table 69:

* = If the cylinder head features valve seat inserts, it is not necessary to use an anti-wear additive in the fuel.

If anti-wear additives are mixed in, this wear can be reduced. The approved supplementary additives must be mixed with the fuel in the predefined concentration. The additive must be filled before every refueling.

Approved anti-wear additives

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

Table 70:

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

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 are listed in table (→ Page 111).

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 application of biocides with halogenated compounds is prohibited due to their effects on the engine system and the environment.

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

Approval 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	Dieselcure Fuel Decontaminant	1 : 1200 (833 mg/kg)

Manufacturer	Brand name	Concentration for use
Adolf Würth GmbH & Co. KG Reinhold Würth-Straße 12-17 74653 Künzelsau Tel. +49 (0) 7940 152248	Dieselcure Fuel Decontaminant	1 : 1200 (833 mg/kg)
Vink Chemicals GmbH & Co. KG Eichenhöhe 29 21255 Kakenstorf Tel. +49 (0) 4186 887970 E-mail: info@vink-chemicals.com	grotamar 71 grotamar 82 StabiCor 71	0.5 l/ton 1.0 l/1000 l 0.5 l/ton
DOW® https://www.dow.com/en-us/about-dow/locations	Kathon™ FP 1.5 Biocide	100–200 mg/kg
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 Netherlands	DieselPower Biocontrol (früher Dieselpower MAR71)	333 ml/ton

Table 71:

Cleaning additives

Under very unfavorable conditions, e.g. aging of fuels, deposits may occur in the injectors. These deposits can be removed with cleaning additives. The additive approved by Rolls Royce Solutions is listed in table (→ Table 72).

Manufacturer	Brand/product name	Concentration for use	Notes	Approval for
The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, Ohio 44092 U.S. Tel. +1 440-943-4200	Powerzol 9049	One-time application for injector cleaning in case of deposit formation (push cleaning): 0.3% by volume Continuous application for prevention of coating and deposits: 0.02 to 0.1% by volume	Observe the safety data sheet of the manufacturer and introduce appropriate protective measures! The service life of the fuel filters can be reduced through the use of an additive.	4000Gx3/Gx4 and Gx5 (all application groups, FCO and all emission optimizations)

Table 72:

Flow improvers

Flow improvers cannot 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.

5.5 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:

Consult the relevant Rolls-Royce Solutions specialist department in case of doubt about the use of materials on the engine / externally mounted components in fuel circuits.

6 NOx Reducing Agent AUS 32 / AUS 40 for SCR Exhaust Gas Aftertreatment Systems

6.1 General information

SCR (Selective Catalytic Reduction) catalysts can be used for NO_x emissions reduction. The reducing agent (urea-water solution with an urea concentration of 32.5% or 40%) 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 or ISO 18611-1 is mandatory.

With ISO 18611-1, the cleanness requirements (→ Table 72) that deviate from the standard must be observed.

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 / ISO 18611-2. The following table (→ Page 115) shows the quality characteristics and associated test procedures for reducing agents (extract from the standard ISO 222 41-1 and ISO 18611-1).

mtu SCR systems are usually designed for a concentration of 32.5 % urea.

For Series 2000 marine engines with SCR (12V2000M41A IMO III / 2000Mx7), the use of the NOx reducing agent with 40% (AUS40) is also permitted.

For Series 4000 marine engines with SCR, Series 4000 M03 (8V4000M63 IMO III / 12V4000M73L, M93, M93L / 16V4000M73, M73L, M93 / 20V4000M73L, M93 / 20V4000M53B IMO III) and Series 4000 M05, the use of the NOx reducing agent with 40% urea (AUS40) is also permitted.

Important

The purity requirements for the reducing agent then correspond to those in the standards for AUS 32 / AUS 40 (in accordance with ISO 222 41-1 or ISO 18611-1, see table (→ Page 115)).
The use of AUS 32 or AUS 40 with a lower purity level can lead to shortened maintenance intervals for the SCR substrates.
A mixture in the tank of 32.5% and 40% reducing agent is permitted for the above-mentioned engines.

Important

The use of antifreeze additives for AUS 32 and AUS 40, or so-called winter urea, is generally not approved.

Quality parameters and test procedures for reducing agent AUS 32 / AUS 40

	Unit	Test method ISO	Limit values for AUS 32	Limit values for AUS 40
Urea content	by weight %	18611–2 Annex B	31.8 - 33.2	39 - 41
Spec. gravity at 20 °C	kg/m^3	3675 12185	1087.0 - 1092.0	1105 - 1177
Refractive index at 20 °C		18611–2 Annex C	1.3817 - 1.3840	1.3947 - 1.3982
Alkalinity as NH_3	by weight %	18611–2 Annex D	Max. 0.2	Max. 0.5
Biuret content	by weight %	22241–2 Annex E	Max. 0.3	Max. 0.3

	Unit	Test method ISO	Limit values for AUS 32	Limit values for AUS 40
Aldehyde content	mg/kg	22241–2 Annex F	Max. 5	Max. 5
Non-soluble constituents	mg/kg	22241–2 Annex G	Max. 20	Max. 20
Phosphate content as $P0_4$	mg/kg	22241–2 Annex H	Max. 0.5	Max. 0.5
Metal contents		22241–2 Annex I		
Calcium	mg/kg		Max. 0.5	Max. 0.5
Iron	mg/kg		Max. 0.5	Max. 0.5
Copper	mg/kg		Max. 0.2	Max. 0.2
Zinc	mg/kg		Max. 0.2	Max. 0.2
Chrome	mg/kg		Max. 0.2	Max. 0.2
Nickel	mg/kg		Max. 0.2	Max. 0.2
Aluminum	mg/kg		Max. 0.5	Max. 0.5
Magnesium	mg/kg		Max. 0.5	Max. 0.5
Sodium	mg/kg		Max. 0.5	Max. 0.5
Potassium	mg/kg		Max. 0.5	Max. 0.5
Identity		ISO 22241-2 Annex J	Identical with the reference sample	Identical with the reference sample

Table 73:

Storage of reducing agent

For instructions on storage, packing, transport and suitable/unsuitable materials in the reducing agent circuit, refer to the standard ISO 222 41-3 or ISO 18611-3. The instructions of the manufacturer must be observed.

Important
AUS 32 (AdBlue) crystallizes at -11 °C. AUS 40 (AdBlue) crystallizes at 0 °C. Avoid direct sunlight because it promotes the occurrence of microorganisms and the decomposition of the reducing agent.

7 Approved Engine Oils and Lubricating Greases

7.1 Engine Oils for Four-Cycle Engines

7.1.1 Series-based usability of engine oils of oil category 1

Series	Oil category 1 Single-grade oils SAE 30/40	Oil category 1 Multi-grade oils	Comments
S60	No	No	
099	Yes	Yes	
183	Yes	Yes	
396	Yes	Yes	
538	Yes	Yes	
595	Yes	Yes	Not for fast commercial vessels
956 Emergency power, Genset	No	No	
956-01 Marine, Rail	No	No	
956-02 Marine, Rail	No	No	
956TB31 Nuclear power station emergency power	No	No	
956TB32 Nuclear power station emergency power	No	No	
956TB33 Nuclear power station emergency power (Ɛ = 9)	No	No	
956TB33 Nuclear power station emergency power (Ɛ = 12)	No	No	
956TB34 Nuclear power station emergency power	No	No	
1163-02 Marine	No	No	Not for fast commercial vessels
1163-02 TB32 Nuclear power station emergency power	No	No	
1163-02 TB32 Emergency power, Genset	No	No	
1163-03 Marine	Yes	Yes	
1163-04 Marine	No	No	

Series	Oil category 1 Single-grade oils SAE 30/40	Oil category 1 Multi-grade oils	Comments
2000Cx0 / Cx1 / Cx2	Yes	Yes	
2000Cx6	No	No	
2000Gx5	Yes	Yes	
2000Gx6 / Gx7	No	No	
2000Mx0 / Mx1	Yes	Yes	
2000M41A IMO III	No	No	
2000Mx2/Mx3	Yes	Yes	Except M72
2000Mx4 / Mx6 / Mx7	No	No	
2000Px2	Yes	Yes	
2000Sx0 / Sx1 / Sx2	Yes	Yes	
2000Sx6	No	No	
4000-00	Yes	Yes	
4000-01	Yes	Yes	
4000-02	Yes	Yes	
4000-03G (Anwgr. 3A) / C / P / S	Yes	Yes	
4000-03G außer Anwgr. 3A	No	No	
4000M23F - M63L	Yes	Yes	Not permitted for operation with SCR (selective catalytic reduction) systems
4000M53B / M73-M93L / N43 / N83	No	No	
4000M73- M93L IMO II SCR ready	No	No	
4000M73- M93L IMO III	No	No	
4000R33 / R43 / R53	Yes	Yes	
4000R63x	No	No	
12V4000U83	No	No	
4000-04B	Yes	Yes	
4000-04C	No	No	
4000-04G	No	No	
4000-04M	No	No	
4000R54 / R64 / R74 / R84	No	No	
4000-04T	No	No	
4000-05C / G / T	No	No	
4000-05 M IMO II	No	No	

Series	Oil category 1 Single-grade oils SAE 30/40	Oil category 1 Multi-grade oils	Comments
4000-05 M IMO III / EPA T4	No	No	
20V4000M53B IMO III	No	No	
8V4000M63 IMO III	No	No	
8000	No	No	

Table 74:

Yes = Approval granted

No = No approval

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

For details and special properties, see the chapter on "Lubricants for four-stroke cycle engines" (→ Page 7)

Single-grade oils

Important

[1] = No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life

Single-grade oils – Category 1, SAE grades 30 and 40 for diesel engines						
Manufacturer	Brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Aegean Oil SA	Vigor Super D	40	X			
Castrol Ltd.	Castrol MLC	30, 40		X		
ELDON'S SA	ELDON'S ELONA ULTRA SAE 40	40	X			
Gulf Oil International	Gulf Superfleet	40	X			[1]
LPC S.A.	Cyclon D Prime	30, 40	X			
Motor Oil (Hellas)	EMO Turbo Champion Plus	30, 40	X			
	EMO Turbo Champion	40		X		
Petrobras Distribuidora S.A.	Marbrax CCD-310	30		X		
	Marbrax CCD-410	40		X		
PT. Pertamina Lubricants	Meditiran SMX	40	X			
Repsol Lubricantes y Especialidades, S.A.	REPSOL GIANT 1020	30, 40		X		
	Repsol Marino 3	30		X		[1]
	Repsol Marino 3 SAE 40	40			X	[1]
Shell International Petroleum Company	Shell Rimula R3+	30	X			

Table 75:

7.1.3 Multi-grade oils – Category 1, SAE grade 15W-40 for diesel engines

For details and special properties, see the chapter on "Lubricants for four-stroke cycle engines" (→ Page 7).

Important
[1] = No longer included in the portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life. [2] = Engine oils marked [2] are also approved for Series 60 engines

Multi-grade oils

Multi-grade oils – Category 1, SAE grade 15W-40 for diesel engines						
Manufacturer	Brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
ENI S.p.A	eni i-Sigma universal DL	15W-40	X			[1]
Manufacture Zavod imeni Shaumyana	M5z/14D $_2$CE	15W-40			X	[1]
Unil Opal	Intercooler 400	15W-40	X			[1]

Table 76:

7.1.4 Series-based usability of engine oils of oil categories 2 and 2.1 (low SAPS oils)

Series	Oil category 2 Single-grade oils	Oil category 2 Multi-grade oils	Oil category 2.1 (low SAPS oils) Multi-grade oils	Comments
S60	No	Restricted[1)]	Restricted[2)]	[1)] = Only 15W-40 and min. API CH-4 [2)] = Only 15W-40 and min. API CJ-4
099	Yes	Yes	Yes	
183	Yes	Yes	Yes	
396	Yes	Yes	Yes	
538	Yes	Yes	Yes	
595	Yes	Yes	Yes	
956 Emergency power, Genset	Yes	Yes	No	
956-01 Marine, Rail	Yes	Yes	No	
956-02 Marine, Rail	Yes	Yes	No	
956TB31 Nuclear power station emergency power	Restricted[3)]	No	No	[3)] = Only named products according to restrictions for applications of Series 956 TB31/ TB32/TB33 and 1163 TB32 (→ Page 7)
956TB32 Nuclear power station emergency power	Restricted[4)]	No	No	[4)] = Only named products according to restrictions for applications of Series 956 TB31/ TB32/TB33 and 1163 TB32 (→ Page 7)
956TB33 Nuclear power station emergency power (Ɛ = 9)	Restricted[5)]	No	No	[5)] = Only named products according to restrictions for applications of Series 956 TB31/ TB32/TB33 and 1163 TB32 (→ Page 7)
956TB33 Nuclear power station emergency power (Ɛ = 12)	Restricted[6)]		No	[6)] = Only named products according to restrictions for applications of Series 956 TB31/ TB32/TB33 and 1163 TB32 (→ Page 7)

Series	Oil category 2 Single-grade oils	Oil category 2 Multi-grade oils	Oil category 2.1 (low SAPS oils) Multi-grade oils	Comments
956TB34 Nuclear power station emergency power	Restricted[7)]		No	[7)] = Only named products according to restrictions for applications of Series 956 TB31/ TB32/TB33 and 1163 TB32 (→ Page 7)
1163-02 Marine	Yes	Yes	Yes	
1163-02 TB32 Emergency power, Genset	Yes	Yes	No	
1163-02 TB32 Nuclear power station emergency power	Restricted[8)]	No	No	[8)] = Only named products according to restrictions for applications of Series 956 TB31/ TB32/TB33 and 1163 TB32 (→ Page 7)
1163-03 Marine	Yes	Yes	Yes	
1163-04 Marine	Yes	Yes	Yes	
2000Cx0 / Cx1 / Cx2 / Cx6	Yes	Yes	Yes	
2000Gx5 / Gx6 / Gx7	Yes	Yes	Yes	
2000Mx0 / Mx1	Yes	Yes	Yes	
2000Mx2 (except M72) / Mx3 / Mx4 / Mx6	Yes	Yes	Yes	
2000M41A IMO III	No	No	Yes	
2000Mx7	No	No	Yes	
2000M72	Yes[9)]	Yes	Yes	[9)] = Except: • Power Guard® SAE 40 Off-Highway Heavy Duty • Mobil Delvac Legend 1630/1640 • Mobilgard ADL30/40
2000Px2	Yes	Yes	Yes	
2000Sx0 / Sx1 / Sx2 / Sx6	Yes	Yes	Yes	
4000-00	Yes	Yes	Yes	
4000-01	Yes	Yes	Yes	
4000-02	Yes	Yes	Yes	
4000-03G / S / P / C	Yes	Yes	Yes	

Series	Oil category 2 Single-grade oils	Oil category 2 Multi-grade oils	Oil category 2.1 (low SAPS oils) Multi-grade oils	Comments
4000-03Gx3F / Gx3G / Gx3H	Yes	Yes	Yes	
4000M23F - M63L	Yes[10)]	Yes[10)]	Yes	[10)] = Not permitted for operation with SCR (selective catalytic reduction) systems
4000M53 / M73-M93L / N43 / N83	Yes[11)]	Yes[11)]	Yes	[11)] = Not permitted for operation with SCR (selective catalytic reduction) systems
4000M73-M93L IMO II SCR ready	Yes	Yes	Yes	
4000M73-M93L IMO III	No	No	Yes	
4000R33 / R43 / R53	Yes	Yes	Yes	
4000R63x	Yes	Yes	Yes	
12V4000U83	Yes	Yes	Yes	
4000-04 B	Yes	Yes	Yes	
4000-04 C	No	No		
4000-04 G	Yes	Yes	Yes	
4000-04 M	Yes	Yes	Yes	
4000R54 / R64 / R74 / R84	No	No	No	
4000-04 T	No	No	Only Chevron Delo 400 LE 15W-40	
4000-05 C	No	No	Yes[12)]	[12)] = Only 5W-40, 10W-40, 15W-40
4000-05 G	No	No	Yes	
4000-05 M IMO II	Yes	Yes	Yes	
4000-05 M IMO III / EPA T4	No	No	Yes	
20V4000M53B IMO III	No	No	Yes	
8V4000M63 IMO III	No	No	Yes	
4000-05 T	No	No	Yes[13)]	[13)] = Only 5W-40, 10W-40, 15W-40
8000	Restricted[14)]	No	No	[14)]= Only named engine oils Re-approval only after engine test in Series 8000

Table 77:

Yes = Approval granted

No = No approval

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

For details and special properties, see the chapter on "Lubricants for four-stroke cycle engines" (→ Page 7).

Important

[1] = No longer included in the portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
For Series 8000 engines, the approved SAE grade 40 engine oils may only be used in conjunction with pre-heating and oil priming (T_{oil} > 30 °C).

Single-grade oils

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

Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Rolls-Royce Solutions GmbH	Power Guard® DEO SAE 40	40	X			20 l canister: X00062816 210 l canister: X00062817
Rolls-Royce Solutions America Inc.	Power Guard® SAE 40 Off-Highway Heavy Duty	40		X		5 gallons: 23532941 55 gallons: 23532942 Approved for Series 8000 Available from Rolls-Royce Solutions America Inc. Not approved for Series 2000 M72
mtu India Pvt Ltd.	Diesel Engine Oil DEO SAE 40	40		X		50 l canister: 73333/P 205 l canister: 75151/D [1] Sale of Indian oil only intended on Indian market
AEGEAN OIL S.A.	AEGEAN VIGOR M SAE40	40	X			
BayWa AG	Tectrol HD 30	30		X		[1]
	Tectrol HD 40	40		X		[1]
Belgin Madeni Yaglar	Lubex Marine LTM-30	30		X		
	Lubex Marine LTM-40	40		X		
	BELGIN LUBEX MARINE LTX Plus 30	30		X		
	BELGIN LUBEX MARINE LTX Plus 40	40		X		
Castrol Ltd.	Castrol HLX	30			X	Approved for fast commercial vessels up to 1500 h, Series 595, 1163 Approved for Series 8000
	Castrol HLX	40			X	Approved for fast commercial vessels up to 1500 h, Series 595, 1163 Approved for Series 8000

Single-grade oils – Category 2, SAE grades 30 and 40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Chevron Lubricants (Texaco)	Delo 400	30		X		Approved for Series 8000
	Delo 400	40		X		Approved for Series 8000
	Delo Gold	40		X		
Delek	Delkol Super Diesel	40		X		1)
	Delkol Super Diesel MT Mono	40	X			1)
EKO ABEE	EKO MARINE MT 40	40		X		
ENOC Marketing L.L.C.	ENOC Strata Super Duty	40		X		
Exxon Mobil Corporation	Mobil Delvac Legend 1630	30		X		Not approved for Series 2000 M72
	Mobil Delvac Legend 1640	40		X		Not approved for Series 2000 M72
	Mobilgard ADL 30	30		X		Not approved for Series 2000 M72 Approved for Series 8000
	Mobilgard ADL 40	40		X		Not approved for Series 2000 M72 Approved for Series 8000
Fuchs Lubrifiant France s. a.	Titan Marine Otan O-278 OMD 113	40			X	
Fuchs Petrolub SE	Titan Universal HD	30, 40	X			
	Titan EM 30 MTU	30	X			Enhanced corrosion protection
	Titan Universal HD SAE 30 mtu	30	X			Enhanced corrosion protection
GS Caltex Corporation	Kixx HD SAE 40	40	X			
	MPA 300 SAE 30	30	X			
	MPA 300 SAE 40	40	X			
Gulf Oil International	Gulf Superfleet Plus	40	X			1)
Hyrax Oil Sdn Bhd	Hyrax Top Deo	40	X			
Koçak Petrol Ürünleri San. ve. TIC. Ltd.	Speedol Deniz Dizel Motor Yağı	30, 40		X		
Kuwait Petroleum	Q8 T 750	30, 40	X			
LPC s. a.	Cyclon D Super	40		X		
Manufacture Zavod imeni Shaumyana Ltd.	M-14D2CE	40			X	1)
Motor Oil, Hellas	EMO SHPD Plus	30, 40		X		
Motorex AG	Motorex Monolube	30		X		
Paz Lubricants & Chemicals	Paz Marine S 40	40	X			

Single-grade oils – Category 2, SAE grades 30 and 40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Petrobras Distribuidora s. a.	Marbrax CCD-310-AP	30		X		
Petrogal, s. a.	Galp Galaxia 40	40		X		
Shell International Petroleum Company	Shell Sirius X	30			X	Approved for Series 8000
	Shell Sirius X	40			X	Approved for Series 8000
Sonol	Seamaster 40	40	X			1)
SRS Schmierstoff Vertriebs GmbH	SRS Rekord plus 30	30		X		
	SRS Rekord plus 40	40		X		
	SRS Antikorrol M plus	30		X		Enhanced corrosion protection Only permitted for running-in and standard production acceptance, max. ten operating hours; with the exception of Series 4000T04/T05/R04/R05: Max. 3.5 operating hours applies here
	SRS Motorenöl O-278	40		X		1)
Total Lubrifiants	Total Caprano MT 30	30			X	
	Total Caprano MT 40	40			X	
	Total Disola MT 30	30	X			
	Total Disola MT 40	40	X			
	Total Rubia MT 30	30			X	
	Total Rubia MT 40	40			X	

Table 78:

7.1.6 Multi-grade oils – Category 2, SAE grades 10W-30, 10W-40, 15W-40 and 20W-40 for diesel engines

For details and special properties, see the chapter on "Lubricants for four-stroke cycle engines" (→ Page 7).

Important

[1] = No longer included in the portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
[2] Engine oils marked [2] are also approved for Series 60 engines.

Multi-grade oils

Multi-grade oils – Category 2, SAE grades 10W-30, 10W-40, 15W-40 and 20W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Rolls-Royce Solutions GmbH	DEO SAE 15W-40 Ultra	15W-40		X		20 l canister: X00084315 210 l barrel: X00084316
	Diesel Engine Oil DEO SAE 15W-40 [1]	15W-40		X		Product replaced by DEO SAE 15W-40 Ultra.
Rolls-Royce Solutions Asia Pte. Ltd.	Diesel Engine Oil - DEO SAE 15W-40 Ultra	15W-40		X		20 l canister: 60633/P 210 l canister: 60335/D
Rolls-Royce Solutions Suzhou Co. Ltd. China	Diesel Engine Oil - DEO 15W-40	15W-40		X		16 kg canister: X00087293 170 kg canister: X00087294
PT. Rolls-Royce Solutions Indonesia	Diesel Engine Oil - DEO SAE 15W-40 Ultra	15W-40		X		20 l canister: X00060333/P 210 l canister: 60335/D
mtu India Pvt. Ltd.	Diesel Engine Oil - DEO 15W-40 Ultra	15W-40		X		50 l canister: 63333/P[2] 205 l canister: 65151/D Sale only intended in Indian market
Adnoc Distribution	Adnoc Voyager Plus	15W-40		X		[2]
Aegean Oil S.A.	Vigor Turbo SD 15W-40	15W-40	X			[1] [2]
Addinol Lube Oil GmbH	Addinol Diesel Longlife MD1548	15W-40		X		[2]
AP Oil	AP X-Super Dieselube Turbo CF-4	15W-40	X			[1]
Aral AG	Aral Turboral	10W-40		X		
	Aral Turboral	15W-40		X		[2]
Aramco Lubricants and Retail Company	Orizon HD vB	15W-40	X			[1] [2]
	Orizon HD vE	15W-40		X		[1] [2]

Multi-grade oils – Category 2, SAE grades 10W-30, 10W-40, 15W-40 and 20W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
BayWa AG	Tectrol Turbo 4000	10W-40		X		
	Tectrol Super Truck 1540	15W-40			X	
Belgin Madeni Yaglar	BELGIN LUBEX ROBUS PRO 15W-40	15W-40		X		2)
	LUBEX MARINA M	15W-40		X		
BP p.l.c.	BP Vanellus Multi-Fleet	15W-40		X		2)
	BP Vanellus Multi A	15W-40		X		2)
	BP Vanellus Multi A 15W-40	15W-40		X		2)
Castrol Ltd.	Castrol CRB Multi 15W-40 CI-4/E7	15W-40		X		2)
	Castrol CRB Turbomax 15W-40 CI-4SLE7	15W-40		X		2)
	Castrol Rivermax CRB 15W-40 CI-4/E7	15W-40		X		2)
	Castrol RX Diesel 15W-40 CI-4/E7	15W-40		X		2)
	Castrol RX Diesel 15W-40 CI-4 Plus/E7	15W-40		X		2)
	Castrol Vecton 15W-40 CI-4/E7	15W-40		X		2)
	Castrol Vecton 15W-40 CI-4 Plus/SL/E7				X	2)
Cepsa Comercial Petroleo S.A.U.	Traction Max SAE 15W-40	15W-40		X		1) 2)
Champion Chemicals N.V.	Champion New Energy	15W-40		X		2)
Chevron Lubricants (Caltex)	Delo Gold Multigrade SAE 15W-40	15W-40	X			
	Delo Gold Ultra	15W-40		X		2)
	Delo Gold Ultra E	10W-40		X		1)
	Delo Gold Ultra E	15W-40	X			2)
Chevron Lubricants (Texaco)	Ursa Super TD SAE 15W-40	15W-40		X		2)
	Ursa Premium TDX	15W-40		X		1) 2)
	Ursa Heavy Duty	15W-40	X			
CPC Corporation, Taiwan	CPC Superfleet CG4 Motor Oil	15W-40	X			
	CPC MARILUBE OIL 9250M	15W-40	X			
Delek Industries Ltd.	Super Diesel	15W-40		X		1)
Dunwell Petro-Chemical Co., Ltd.	Apex Super Motor Oil SL/CI-4, 15W-40	15W-40		X		1) 2)
EKO ABEE	Eko Forza plus	15W-40	X			
	EKO Marine Plus 15W-40	15W-40	X			2)
	EKO Marine Premium 15W-40	15W-40		X		2)
eni S.p.A.	eni i-Sigma performance E7	15W-40	X			2)

Multi-grade oils – Category 2, SAE grades 10W-30, 10W-40, 15W-40 and 20W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
ENOC MARKETING LLC	ENOC VULKAN 770X SUPER	15W-40		X		2)
ESSO Deutschland GmbH	MOBIL DELVAC MODERN 15W-40 EXTREME DEFENSE	15W-40		X		2)
Exol Lubricants Ltd.	Taurus Extreme HST	15W-40		X		1) 2)
Exxon Mobil Corporation	Mobilgard HSD 15W-40 CH-4	15W-40	X			
	Mobilgard HSD 15W-40 CI-4	15W-40		X		
	Mobilgard 1 SHC	20W-40			X	Approved for fast commercial vessels up to 1500 h, 396, 1163
	Mobil Delvac Advanced City Logistcs	15W-40	X			
	Mobil Delvac Legend 15W-40 Heavy Duty	15W-40		X		2)
	Mobil Delvac Legend CH-4 15W-40 Heavy Duty	15W-40	X			
	Mobil Delvac Mining 15W-40	15W-40		X		1) 2)
	Mobil Delvac Modern 15W-40 Super Defense	15W-40	X			2)
	Mobil Delvac Modern 15W-40 Super Defense Mine V2	15W-40		X		2)
	Mobil Delvac Modern 15W-40 Super Defense V3	15W-40	X			
	Mobil Delvac MX	15W-40		X		2)
	Mobil Delvac MX Extra	10W-40		X		
	Mobil Delvac Super 1300 C	15W-40	X			
	Mobil Delvac Super 1400	15W-40	X			
Finke Mineralölwerk GmbH	AVIATICON Turbo Super	15W-40	X			2)
	AVIATICON Turbo D 10W-40	10W-40		X		
Fuchs	TITAN SHPD SAE 15W-40	15W-40		X		2)

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Multi-grade oils – Category 2, SAE grades 10W-30, 10W-40, 15W-40 and 20W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Fuchs Petrolub SE	Fuchs Max Way	15W-40		X		1) 2)
	Pentotruck	15W-40		X		1) 2)
	Fuchs Titan Truck	15W-40	X			2)
	Fuchs Titan Truck Plus	10W-30		X		
	Fuchs Titan Truck Plus	15W-40		X		2)
	Fuchs Titan Unimax Plus MC	10W-40		X		1)
	Fuchs Titan Unimax Ultra MC	10W-40		X		1)
	Fuchs Titan Universal HD	15W-40	X			
	TITAN TRUCK PLUS SAE 15W-40	15W-40		X		2)
Glide Technology SDN BHD	MonsterGlide Hyper F SAE 15W-40 API CI-4/SL	15W-40		X		2)
GS Caltex India Pvt. Ltd.	Kixx HD 1 SAE 10W-40	10W-40		X		
	Kixx HD 1 SAE 15W-40	15W-40		X		2)
GUANGXI BEIHAI YUCHAI PETRONAS HIGH QUALITY LUBE CO. LTD	HanHu Generator Set Oil CH-4 15W-40	15W-40	X			2)
	HanHu Long Drain Diesel Engine Oil CI-4 15W-40	15W-40	X			2)
Gulf Oil International	Gulf Super Duty VLE	15W-40	X			
	Gulf Superfleet LE	10W-40		X		
	Gulf Superfleet Supreme	10W-40		X		
	Gulf Superfleet Supreme	15W-40		X		2)
	Gulf Superfleet Plus	15W-40	X			1)
Gulf Oil Marine Ltd.	GulfSea Power MX 15W-40	15W-40		X		2)
Hellenic Fuels and Lubricants Single Member Industrial and Commercial S.A. (EKO ABOEE)	EKO FORZA PREMIUM 15W-40	15W-40		X		2)
Hessol Lubrication GmbH	Hessol Turbo Diesel	15W-40		X		1) 2)
	Hessol Super Longlife	10W-40		X		1)
Hindustan Petroleum	HP MILCY MTU 15W-40	15W-40		X		2)
Hyrax Oil Sdn Bhd	Hyrax Admiral 15W-40	15W-40	X			1) 2)
INA Maziva Ltd.	INA Super Max	15W-40		X		2)

Multi-grade oils – Category 2, SAE grades 10W-30, 10W-40, 15W-40 and 20W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Indian Oil Corporation Limited	Servo Premium (N) 15W-40	15W-40		X		2)
	Servo Pride Supreme XL	15W-40		X		1) 2)
Kuwait Petroleum	Q8 T 750	15W-40	X			2)
	Q8 T 800	10W-40	X			2)
Kocak Petrol Ürünleri San	Speedol SHPD Tirot 15W-40	15W-40		X		
LAUGFS Lubricants Limited	D-TRON ACTIVTECH, SAE 15W-40, API CI-4	15W-40		X		
Liqui Moly GmbH	Liqui Moly Marine 4T Motor Oil	15W-40		X		2)
	Liqui Moly Touring High Tech SHPD	15W-40		X		2)
Lotos Oil	Turdus Powertec 1000	15W-40		X		1) 2)
LPC S.A.	Cyclon D Super	15W-40	X			
	Cyclon Granit Maximum	15W-40		X		2)
Lubricants UK Limited	Castrol CRB Rivermax 15W-40	15W-40		X		2)
	Castrol RX Diesel 15W-40	15W-40		X		2)
	Castrol VECTON 15W-40	15W-40		X		2)
MOL-LUB Ltd.	Mol Dynamic Transit 10W-40	10W-40		X		
Motor Oil, Hellas	EMO SHPD Plus	15W-40		X		
Novergy Chemicals, Corp.	Chronus Eco Classic Heavy Duty Diesel Multigrade Oil API CI-4 SAE 15W-40	15W-40		X		2)
Orlen Oil	Platinum Ultor Plus	15W-40			X	2)
Oryx Energies	Enduro 600	15W-40		X		1)
PETROBRAS DISTRIBUIDORA S.A.	LUBRAX NAUTICA DIESEL	15W-40		X		2)
	LUBRAX TOP TURBO	15W-40		X		2)
PetroChina Lubricant Company	Tianwei CH-4 15W-40 diesel engine	15W-40	X			2)
Petrol Ofisi A.Ş	Petrol Ofisi Maximus Turbo Diesel Extra	15W-40		X		2)
Petron Corporation	Petron Rev-x Premium Multi Grade	15W-40		X		1) 2)
Petronas Lubricants International	Petronas Urania 3000	15W-40				2)
	Urania 3000 LS 10W30	10W-30	X			
	Petronas Urania LD7	15W-40		X		1)
Petronas Lubricants Italy S.p.A.	PETRONAS ARBOR ALFATECH 15W-40	15W-40			X	2)
Petromin Oils Company	Petromin Turbomaster XD	15W-40		X		1) 2)

Multi-grade oils – Category 2, SAE grades 10W-30, 10W-40, 15W-40 and 20W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Prista Oil Holding EAD	Pro Auto HDEO E7 15W-40	15W-40		X		2)
PT Pertamina Lubricants	Meditran SX	15W-40		X		1) 2)
	Meditran SX Plus	15W-40		X		1)
Puma Energy S.A.	Puma HD Plus	15W-40		X		1) 2)
Qatar Lubricants Company Ltd.	QALCO Topaz HMF	15W-40	X			
Raloy Lubricantes, S.S. de C.V.	Raloy Diesel Power	15W-40		X		2)
RAMOIL SPA	DUGLAS OIL SUPER LIFE 15W-40 SHPDO	15W-40		X		1) 2)
Ravensberger Schmierstoffvertrieb GmbH	RAVENOL Expert SHPD	10W-40		X		1)
	RAVENOL Turbo Plus SHPD	15W-40		X		1)
	RAVENOL Mineralöl Turbo Plus SHPD	15W-40	X			1) 2)
Repsol Lubricantes y Especialidades, S.A.	REPSOL GIANT 7530 15W-40	15W-40		X		2)
	REPSOL GIANT 7540 15W-40	15W-40		X		2)
	REPSOL GIANT 7410	15W-40	X			2)
ROLF Lubricants GmbH	Rolf Krafton M5 U 15W-40	15W-40		X		
ROWE Mineralölwerk GmbH	ROWE Hightec Formula GT SAE	10W-40		X		
	ROWE Hightec Formula GT SAE 10W-40 HC	10W-40		X		
	ROWE Hightec Turbo HD 15W-40 Plus	15W-40		X		2)

Multi-grade oils – Category 2, SAE grades 10W-30, 10W-40, 15W-40 and 20W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Shell International Petroleum Company	Shell Fleet CI-4	10W-40		X		
	Shell HD4 CHN	15W-40		X		2)
	Shell HD5 Plus	10W-40		X		
	Shell Rimula Light Duty	10W-40		X		
	Shell Rimula R3 MV	15W-40	X			2)
	Shell Rimula R3 Turbo	15W-40		X		2)
	Shell Rimula R3 X	15W-40	X			2)
	Shell Rimula R4	15W-40		X		2)
	Shell Rimula R4 Multi	15W-40		X		2)
	Shell Rimula R4 Plus	15W-40		X		2)
	Shell Rimula R4 X	15W-40		X		2)
	Shell Rimula RT4 X	15W-40		X		2)
	Shell Rimula R5	10W-40		X		
	Shell Rimula R5 E	10W-40		X		
	Shell Rimula T4	15W-40		X		2)
	Shell Sirius S4	15W-40		X		2)
	Eicher Premium Plus Diesel Engine Oil	15W-40		X		2)
Shell International Petroleum Company, London	Shell Rimula R5 E	10W-40		X		
	Shell Rimula Select R5	10W-40		X		
	Shell Fleet CI-4	10W-40		X		
Singapore Petroleum Company Limited	SPC SDM 900 SAE 15W-40	15W-40		X		
Sinopec Lubricant Co., Ltd..	Sinopec Tulux T500	15W-40		X		2)
SRS Schmierstoff Vertrieb GmbH	SRS Motorenöl O-236	15W-40	X			2) Enhanced corrosion protection
	SRS Multi Rekord top	15W-40		X		2)
	SRS Multi Rekord plus	15W-40	X			
	SRS Turbo Rekord	15W-40	X			1) 2)
	SRS Turbo Rekord NG	15W-40		X		2)
	SRS Cargolub TFE	15W-40		X		
	SRS Cargolub TFX	10W-40		X		

Multi-grade oils – Category 2, SAE grades 10W-30, 10W-40, 15W-40 and 20W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
TotalEnergies Lubrifiant	Caprano TDH 15W-40	15W-40		X		
	Caprano TDI 15W-40	15W-40		X		2)
	HITACHI ENGINE OIL DH-1 15W-40	15W-40		X		2)
	RUBIA TIR 7400 SAE 15W-40	15W-40		X		
	Rubia Works 1000 15W-40	15W-40		X		2)
	TP MAX 10W-40	10W-40		X		
	Tractagri HDX 15W-40	15W-40				2)
Total Lubrifiants	Caprano TDI	15W-40		X		2)
	Caprano TDI FE 10W-30	10W-30		X		
	Rubia Works 1000 FE 10W-30	10W-30		X		
	Hitachi Genuine Engine Oil 15W40 DH-1	15W-40		X		1) 2)
UMW Grantt International Sdn Bhd	GRANTT QUASAR SAE 15W-40 API CI-4	15W-40		X		2)
Unil Opal	Medos 700	15W-40			X	1) 2)
Valvoline EMEA	All-Fleet Extra SAE 15W-40	15W-40	X			1) 2)
	Valvoline All-Fleet Extra	15W-40		X		1) 2)
Veedol International Limited	VEEDOL DIESEL STAR EXTRA15W-40	15W-40		X		1) 2)
Wolf Oil Corporation NV.	Wolf Vitaltech 15W40	15W-40		X		2)
YPF S.A.	Extravida XV 200	15W-40		X		
	Extravida XVI 200	15W-40		X		2)

Table 79:

7.1.7 Multi-grade oils – Category 2.1 (low SAPS oils), SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40 for diesel engines

For details and special properties, see the chapter on "Lubricants for four-stroke cycle engines" (→ Page 7)

Important

[1] = No longer included in the portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
[2] Engine oils marked [2] are also approved for Series 60 engines.

Multi-grade oils

Multi-grade oils – Category 2.1 (low SAPS oils), SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Rolls-Royce Solutions America Inc.	Power Guard® SAE 15W-40 Off-Highway Heavy Duty	15W-40	X			5 gallons: 800133 55 gallons: 800134 IBC: 800135 Available from Rolls-Royce Solutions America Inc. [2]
Rolls-Royce Solutions Suzhou Co. Ltd. China	Diesel Engine Oil - DEO SAE 10W-40	10W-40	X			20 l canister: X00085025
Advanced Lubrication Specialties, Inc.	Advantage Premium Plus	15W-40		X		[2]
	Advantage Ultra Premium Plus	5W-40		X		
Atlantic Grease & Lubricants FZC	Atlantic Super Top Fleet HD-V Diesel Engine Oil SAE 15W-40 CK-4	15W-40		X		
Aramco Lubricants and Retail Company	Orizon HD vF 15W-40	15W-40	X			[2]
	Orizon HD vH 15W-40	15W-40	X			[2]
BayWa AG	TECTROL SUPER TRUCK PLUS XL 1040	10W-40		X		
Calumet Branded Products LLC	Royal Purple Duralec Super 5W-40	5W-40		X		[1]
	Royal Purple Duralec Super 15W-40	15W-40	X			[1] [2]
	Bel-Ray Hyperion Synthetic Blend	10W-30	X			[1]
	Bel-Ray Hyperion Elite Synthetic 5W-40 CK-4	5W-40		X		[1]
Canroyal Oil Lubricants / Dist.	Canroyal Synthetic Diesel Engine Oil	15W-40	X			[1] [2]
Castrol Ltd.	Castrol CRB Mining 15W-40 CK-4	15W-40	X			[2]
	Castrol RX Super 15W-40 CJ-4/E9	15W-40	X			[2]
	Castrol Vecton 15W-40 CK-4/E9	15W-40	X			[2]

Multi-grade oils – Category 2.1 (low SAPS oils), SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Champion Chemicals N.V.	Champion OEM specific 15W40 MS	15W-40	X			1) 2)
	Champion OEM specific 15W40 MS Extra	15W-40	X			2)
Chevron Lubricants (Chevron)	Delo 400 LE	15W-40	X			1) 2) Also approved for Series 4000-04T
	Delo 400 LE Synthetic	5W-40		X		
	Delo 400 MGX	15W-40	X			2)
	Delo 400 SDE	15W-40	X			2)
	Delo 400 SLK	15W-40	X			2)
	Delo 400 XLE	10W-30		X		1)
	Delo 400 XSP	5W-40		X		
Chevron Products Company	Delo 400 SLK SAE 10W-30	10W-30	X			
	Delo 400 SLK SAE 15W-40	15W-40	X			2)

Multi-grade oils – Category 2.1 (low SAPS oils), SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
ExxonMobil Corporation	Mobil Delvac 1 ESP	0W-30	X			
	Mobil Delvac 1 ESP	5W-40		X		
	Mobil Delvac Extreme	15W-40		X		
	Mobil Fleet	15W-40	X			2)
	Mobil Delvac HDEO	15W-40	X			2)
	Mobil Delvac MX ESP 10W-40	10W-40	X			
	Mobil Delvac MX ESP V2 15W-40	15W-40	X			2)
	Mobil Delvac Modern 15W-40 Advanced Protection V1	15W-40		X		2)
	Mobil Delvac Modern 15W-40 Advanced Protection Mine	15W-40				
	Mobil Delvac Modern 15W-40 Advanced Protection Mine V2	15W-40		X		2)
	Mobil Delvac Modern 15W-40 Complete Protection	15W-40	X			2)
	Mobil Delvac Modern 15W-40 Extended Performance	15W-40	X			2)
	Mobil Delvac Modern 10W-40 Full Protection	10W-40	X			
	Mobil Delvac Modern 15W-40 Full Protection Mine V1	15W-40	X			2)
	Mobil Delvac Modern 15W-40 Full Protection Mine V2	15W-40		X		2)
	Mobil Delvac Modern 15W-40 Full Protection V2	15W-40	X			
	Mobil Delvac Ultra 5W-40 Extended Performance	5W-40		X		
	Mobil Delvac Ultra 5W-40 Ultimate Protecton V1	5W-40		X		
	Mobilgard 1 HSD 5W-40	5W-40		X		
eni S.P.A.	Eni i-Sigma top MS 15W40	15W-40	X			2)
Finke Mineralölwerke GmbH	AVIATICON Turbo LA Plus	10W-40	X			2)
	AVIATICON Turbo Premium ECO LA 10W-30	10W-30	X			
	AVIATICON Turbo Super Premium 15W-40	15W-40	X			2)

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Multi-grade oils – Category 2.1 (low SAPS oils), SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Fuchs Petrolub SE	Fuchs Titan Cargo	10W-40	X			1)
	Fuchs Titan Cargo	10W-30	X			
	Fuchs Titan Cargo	15W-40	X			2)
	Titan Cargo SAE 15W-40	15W-40	X			2)
	FUCHS TITAN CARGO MAXX II SAE 5W-30	5W-30			X	
	TITAN CARGO MAXX II SAE10W-40	10W-40			X	
	TITAN CARGO UHPD SAE 15W-40	15W-40	X			2)
	TITAN UHPD SAE 15W-40	15W-40	X			1) 2)
	TITAN UHPD SAE 10W-30	10W-30	X			1)
	PENTOTRUCK PRO SAE 15W-40	15W-40	X			2)
Gulf Oil International	Gulf Supreme Duty XLE	15W-40	X			2)
	Gulf Supreme Duty XLE	10W-30	X			1)
Hitachi Construction Machinery Co, Ltd.	Hitachi Genuine Engine Oil 10W-40 DH-2	10W-40	X			
Kuwait Petroleum	Q8 Formula Truck 7000 FE	10W-30	X			
MPM International Oil Company B.V.	Motor Oil 15W-40 Extra High Performance	15W-40	X			1) 2)
Petro-Canada	Duron HP	15W-40	X			2)
Petronas Lubricants International	Petronas Urania 3000 LS 10W-30	10W-30	X			
Petronas Lubricants, Italy	Petronas Urania 3000 LS	15W-40	X			2)
Phillips 66 Lubricants	Guardol ECT 10W-30	10W-30	X			1)
	Guardol ECT 15W-40	15W-40	X			1) 2)
	Kenndall Super-D XA 10W-30	10W-30	X			1)
	Kenndall Super-D XA 15W-40	15W-40	X			1) 2)
Repsol Lubricantes Y Especialidades, S.A.	REPSOL GIANT 7630 LS 15W-40	15W-40	X			2)
	REPSOL GIANT 7630 LS-FE 10W-30	10W-30	X			2)

Multi-grade oils – Category 2.1 (low SAPS oils), SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Shell International Petroleum Company	Shell Fleet CK-4	10W-30	X			
	Shell Fleet CK-4	10W-40	X			
	Shell Fleet CK-4	15W-40	X			2)
	Shell Rimula RT4L	15W-40		X		2)
	Shell Rotella T3 Fleet	15W-40	X			2)
	Shell Rotella T5	10W-30	X			
	Shell Rimula K4	15W-40	X			1) 2)
	Shell Rimula K6	15W-40	X			2)
	Shell Rimula K8	10W-30	X			
	Shell Rimula K8	10W-40	X			
	Shell Rimula R5 LE	10W-30	X			
	Shell Rimula R5 LE	10W-40	X			
	Shell Rotella T4 Triple Protection	15W-40	X			2)
	Shell Rimula R4 MV	15W-40	X			2)
	Shell Rimula R4 L	15W-40	X			
	Shell Sirius S4L	15W-40	X			2)
SINOPEC Lubricant Co., Ltd.	Sinopec Tulux T700	15W-40	X			2)
SK Enmove Co., Ltd.	ZIC ZS 9000 10W-40	10W-40			X	
	ZIC ZS ULTRA 5W30	5W-30			X	
SRS Schmierstoff Vertrieb GmbH	SRS Turbo Rekord ultra	15W-40	X			2)
	SRS Turbo Rekord ultra V	10W-30	X			
Sunoco Lubricants	Super C	15W-40		X		2)
	Super C Gold	15W-40		X		2)
	Super C Gold Elite	5W-40		X		
The United Oil Company	Duralene Dura-Max 15W-40	15W-40		X		2)
	Duralene Dura-Syn HD	5W-40		X		

Multi-grade oils – Category 2.1 (low SAPS oils), SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40 for diesel engines						
Manufacturer	Product/brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
TotalEnergies Lubrifiants	Caprano TDK 15W-40	15W-40		X		2)
	Caprano TDK FE 10W-30	10W-30	X			
	Hitachi Engine Oil 10W-40	10W-40	X			
	Rubia Optima 1100 15W-40	15W-40	X			2)
	Rubia Works 4000 10W-40	10W-40	X			
	Rubia Works 4000 15W-40	15W-40	X			2)
	Rubia Works 4000 FE 10W-30	10W-30	X			
	Total Star Max FE	10W-30	X			1)
Trinidad & Tobago National Petroleum Marketing Company Ltd. (NPMC)	Ultra Duty 15W-40 Engine Oil	15W-40	X			1) 2)
Wolf Oil Corporation N.V.	Wolf Officialtech 15W40 MS	15W-40	X			1) 2)
	Wolf Officialtech 15W40 MS Extra	15W-40	X			2)

Table 80:

7.1.8 Series-based usability of engine oils of oil categories 3 and 3.1 (low SAPS oils)

Series	Oil category 3 Multi-grade oils	Oil category 3.1 (low SAPS oils) Multi-grade oils	Comments
S60	Restricted[1)]	Restricted[2)]	[1)] = Only 15W-40 and min. API CH-4 [2)] = Only 15W-40 and min. API CJ-4
099	Yes	Yes	
183	Yes	Yes	
396	Yes	Yes	
538	Yes	Yes	
595	Yes	Yes	
956 Emergency power, Genset	Yes	No	
956-01 Marine, Rail	Yes	No	
956-02 Marine, Rail	Yes	No	
956TB31/ 32 Nuclear power station emergency power	Restricted[3)]	No	[3)] = Only named products after engine test according to restrictions for applications of Series 956 TB31/TB32/TB33 and 1163 TB32 (→ Page 7)
956TB33 Nuclear power station emergency power (Ɛ = 9)	Restricted[4)]	No	[4)] = Only named products after engine test according to restrictions for applications of Series 956 TB31/TB32/TB33 and 1163 TB32 (→ Page 7)
956TB33 Nuclear power station emergency power (Ɛ = 12)	Restricted[5)]	No	[5)] = Only named products after engine test according to restrictions for applications of Series 956 TB31/TB32/TB33 and 1163 TB32 (→ Page 7)
956TB34 Nuclear power station emergency power	Restricted[6)]	No	[6)] = Only named products after engine test according to restrictions for applications of Series 956 TB31/TB32/TB33 and 1163 TB32 (→ Page 7)
1163-02 Marine	Yes	Yes	
1163-02TB32 Emergency power, Genset	Yes	No	
1163-02TB32 Nuclear power station emergency power	Restricted[7)]	No	[7)] = Only named products after engine test according to restrictions for applications of Series 956 TB31/TB32/TB33 and 1163 TB32 (→ Page 7)
1163-03 Marine	Yes	Yes	
1163-04 Marine	Yes	Yes	
2000Cx0 / Cx1 / Cx2 / Cx6	Yes	Yes	
2000Gx5 / Gx6 / Gx7	Yes	Yes	
2000Mx0 / Mx1	Yes	Yes	

Series	Oil category 3 Multi-grade oils	Oil category 3.1 (low SAPS oils) Multi-grade oils	Comments
2000Mx2 (except M72) / Mx3 / Mx4 / Mx6	Yes	Yes	
2000M41A IMO III	No	Yes	
2000Mx6	Yes	Yes	
2000Mx7	No	Yes	
2000 M72	Yes[8)]	Yes	[8)] = Except: • Mobil Delvac XHP™ Extra 10W-40 • Mobil Delvac Modern™ Defense V1
2000Px2	Yes	Yes	
2000Sx0 / Sx1 / Sx2 / Sx6	Yes	Yes	
4000-00	Yes	Yes	
4000-01	Yes	Yes	
4000-02	Yes	Yes	
4000-03G (Anwgr. 3A) / C / P / S	Yes	Yes	
4000Gx3F / Gx3G / Gx3H	Yes	Yes	
4000M23F - M63L	Yes[9)]	Yes	[9)] = Not permitted for operation with SCR (selective catalytic reduction) systems
4000M53B / M73-M93L / N43S / N83	Yes[10)]	Yes	[10)] = Not permitted for operation with SCR (selective catalytic reduction) systems
4000M73-M93L IMO II SCR ready	Yes	Yes	
4000M73-M93L IMO III	No	Yes	
4000R33/R43/R53	Yes	Yes	
4000R63x	Yes	Yes	
12V4000U83	Yes	Yes	
4000-04B	Yes	Yes	
4000-04C	Yes[11)]	Yes[11)]	[11)] = Only 5W-40, 10W-40, 15W-40
4000-04G	Yes	Yes	
4000-04M	Yes	Yes	
4000R54	Yes[12)]	Yes[12)]	[12)] = Only 5W-40, 10W-40, 15W-40
4000R64/74/84	No	Yes[13)]	[13)] = Only 5W-40, 10W-40, 15W-40
4000-04T	Yes[14)]	Yes[14)]	[14)] = Only 5W-40, 10W-40, 15W-40
4000-05C	Yes[15)]	Yes[15)]	[15)] = Only 5W-40, 10W-40, 15W-40
4000-05G	No	Yes	
4000-05M IMO II	Yes	Yes	

Series	Oil category 3 Multi-grade oils	Oil category 3.1 (low SAPS oils) Multi-grade oils	Comments
4000-05M IMO III/EPA T4	No	Yes	
20V4000M53B IMO III	No	Yes	
8V4000M63 IMO III	No	Yes	
4000-05T	Yes[17)]	Yes[17)]	[17)] = Only 5W-40, 10W-40, 15W-40
8000	Restricted[18)]	Restricted[18)]	[18)]= Only named engine oils Re-approval only after engine test in Series 8000

Table 81:

Yes = Approval granted

No = No approval

7.1.9 Multi-grade oils – Category 3, SAE grades 5W-30, 5W-40, 10W-40 and 15W-40 for diesel engines

For details and special properties, see the chapter on "Lubricants for four-stroke cycle engines" (→ Page 7).

Important

[1] = No longer included in the portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.

Multi-grade oils

Multi-grade oils – Category 3, SAE grades 5W-30, 5W-40, 10W-40 and 15W-40 for diesel engines						
Manufacturer	Brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Addinol Lube Oil GmbH	Addinol Commercial 1040 E4	10W-40		X		[1]
	Addinol Ultra Truck MD 0538	5W-30			X	[1]
	Addinol Super Truck MD 1049	10W-40			X	
Aral AG	Aral Mega Turboral 10W-40	10W-40			X	[1]
	Aral Super Turboral 5W-30	5W-30			X	
Aramco Lubricants and Retail Company	Orizon HD vA	10W-40		X		[1]
Avista Oil Deutschland GmbH	Avista pure EVO E4	10W-40			X	
	Avista pure EVO SWE	5W-30			X	
	Avista pure EVO SWE	10W-40			X	
BayWa AG	Tectrol Super Truck 1040	10W-40			X	
BP p.l.c.	BP Energol IC-MT 10W-40	10W-40			X	
Castrol Ltd.	Castrol CRB Turbomax 10W-40 E4/E7	10W-40			X	
	Castrol Vecton Long Drain	10W-40			X	
	Castrol Vecton Long Drain 5W-30 E7	5W-30			X	
	Castrol Vecton Long Drain 10W-40 E7	10W-40			X	[1]
	Castrol Vecton Long Drain 10W-40 E4/E7	10W-40			X	
Cepsa Comercial Petroleo Limited	Traction Advanced LD	10W-40			X	[1]
Champion Chemicals N.V.	Champion New Energy 10W40 Ultra	10W-40			X	
Chevron Lubricants (Caltex)	Delo Gold Ultra T SAE 10W-40	10W-40			X	
Chevron Lubricants (Texaco)	Ursa Premium FE	5W-30			X	[1]
Deutsche Ölwerke Lubmin GmbH	AVENO HC PT Diesel	10W-40			X	
eni S.P.A.	eni i-Sigma top 10W-40	10W-40			X	
	eni i-Sigma performance E4	10W-40			X	
Enoc Marketing LLC	Enoc Vulcan 760X Syntech 10W-40	10W-40			X	

Multi-grade oils – Category 3, SAE grades 5W-30, 5W-40, 10W-40 and 15W-40 for diesel engines						
Manufacturer	Brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Exxon Mobil Corporation	Mobil Delvac Modern 10W-40 Super Defense V1	10W-40			X	Not approved for Series 2000 M72
	Mobil Delvac XHP Extra 10W-40	10W-40			X	Not approved for Series 2000 M72
	Mobil Delvac XHP Extra	10W-40			X	
	Mobil Delvac 15W-40	5W-40	X			
	Mobil Delvac 1 SHC 5W-40	5W-40			X	1)
	Mobil Delvac Ultra 5W-40 Ultimate Defense	5W-40			X	
	Mobil Delvac Ultra 5W-40 Ultimate Defense Mine	5W-40			X	
Exol Lubricants Ltd.	Taurus Extreme M3	10W-40			X	
Finke Mineralölwerk GmbH	AVIATICON Finko Truck LD	10W-40			X	
Fuchs Petrolub SE	Fuchs Titan Cargo SL	5W-30			X	
Gulf Oil International	Gulf Fleet Force synth.	5W-30			X	
	Gulf Superfleet ELD	10W-40			X	
	Gulf Superfleet ULD	10W-40			X	
	Gulf Superfleet XLD	10W-40			X	
	Gulf Superfleet Synth ELD	10W-40			X	
INA MAZIVA Ltd.	INA Super E7 SAE 10W-40	10W-40			X	
Kuwait Petroleum	Q8 T 860 10W-40	10W-40			X	
	Q8 T 860 S	10W-40			X	
Motorex AG	MC Power Plus SAE 10W/40	10W-40			X	
Paz Lubricants & Chemicals	Paz Perfect E4	10W-40			X	
Petronas Lubricants International	Petronas Urania 5000 F	5W-30			X	
	Petronas Urania 5000 10W-40	10W-40			X	
Ravensberger Schmierstoff Vertrieb GmbH	RAVENOL Performance Truck	10W-40			X	
Repsol Lubricantes y Especialidades S.A.	REPSOL GIANT 9540 LL	10W-40			X	
	REPSOL GIANT 9550 FE-LL	5W-30			X	
	REPSOL GIANT 9530 LL	10W-40			X	1)
SCT Vertriebs GmbH	Fanfaro TRD E4 UHPD	10W-40		X		
	Mannol TS-6 UHPD Eco	10W-40		X		
	Pemco Diesel G-6 Eco UHPD	10W-40		X		

Multi-grade oils – Category 3, SAE grades 5W-30, 5W-40, 10W-40 and 15W-40 for diesel engines						
Manufacturer	Brand name	SAE viscosity grade	TBN			Comments
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Shell International Petroleum Company	Shell Rimula R5 M	10W-40			X	
	Shell Rimula R6 M	10W-40			X	
	Shell Rimula R6 ME	5W-30			X	
	Shell Rimula R6 ME E4	5W-30			X	
	Shell Rimula R6 ME Extra	5W-30			X	
	Shell Rimula R6 MS	10W-40			X	
	Shell Rimula Select R6	10W-40			X	
SRS Schmierstoff Vertrieb GmbH	SRS Cargolub TFG	10W-40			X	
	SRS Cargolub TFG plus	10W-40			X	
	SRS Cargolub TFG ultra	10W-40			X	
TotalEnergies Lubrifiant	Cubalub ExtraDiesel	10W-40			X	
	RUBIA TIR 8600 10W-40	10W-40			X	
Valvoline EMEA	Valvoline ProFleet M SAE 10W-40	10W-40			X	1)
	Valvoline All Fleet Superior SAE 10W-40	10W-40			X	

Table 82:

7.1.10 Multi-grade oils – Category 3.1 (low SAPS oils), SAE grades 5W-30, 10W-30 and 10W-40 for diesel engines

For details and special properties, see the chapter on "Lubricants for four-stroke cycle engines" (→ Page 7).

Important

[1)] = No longer in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.

Multi-grade oils

Multi-grade oils – Category 3.1 (low SAPS oils), SAE grades 5W-30, 10W-30 and 10W-40 for diesel engines						
Manufacturer	Brand name	SAE viscosity grade	TBN			Comments/material number
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
77 Lubricants	Engine Oil Special UHPD 10W-40	10W-40		X		1)
Addinol Lube Oil GmbH	Addinol Professional 0530	5W-30		X		
	Addinol Professional 1040 E8/E11	10W-40	X			
Aral AG	Aral Mega Turboral LA	10W-40	X			
	Aral Super Turboral LA 5W-30	5W-30		X		
Avia AG	Avia Multi LSP Extra	10W-40		X		1)
Avista Oil Deutschland GmbH	Avista pure EVO GER	10W-40		X		1)
	Avista pure EVO CK-4 SAE 5W-30	5W-30	X			
	Avista pure EVO CK-4 SAE 10W-30	10W-30	X			
	Avista pure EVO CK-4 SAE 10W-40	10W-40	X			
	Avista pure EVO PRIME SWE SAE 5W-30	5W-30			X	
Belgin Madeni Yağlar	BELGIN LUBEX ROBUS MASTER LA 10W-40	10W-40		X		
Castrol Ltd.	Castrol Vecton Long Drain 5W-30 E6/E9	5W-30	X			
	Castrol Vecton Long Drain	10W-30		X		
	Castrol Vecton Long Drain 10W-40 CK-4/E6	10W-40		X		
	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			

Multi-grade oils – Category 3.1 (low SAPS oils), SAE grades 5W-30, 10W-30 and 10W-40 for diesel engines						
Manufacturer	Brand name	SAE viscosity grade	TBN			Comments/material number
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Champion Chemicals N.V.	Champion OEM Specific 10W-40 UHPD MS	10W-40		X		
	Champion OEM Specific 10W-40 UHPD S	10W-40		X		
	Champion OEM Specific 10W40 Ultra MS	10W-40		X		
	Champion OEM Specific 10W40 UHPD Extra	10W-40		X		
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	1)
	Delo 400 XLE LD 10W-40	10W-40		X		
	Delo 400 XLE HD	10W-40			X	
	Delo 400 XSP	5W-30	X			
	Delo 400 XSP-SD	5W-30	X			
Deutsche Ölwerke Lubmin GmbH	AVENO Low SAPS HD Premium 10W-40	10W-40		X		
	AVENO Universal UHPD	10W-40	X			
	Ravenol Euro VI Truck 10W-40	10W-40	X			
Enoc Marketing L.L.C.	Enoc Vulcan 990X ELXD 10W-40			X		
Exol Lubricants Ltd.	Taurus Euro	10W-40		X		

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Multi-grade oils – Category 3.1 (low SAPS oils), SAE grades 5W-30, 10W-30 and 10W-40 for diesel engines						
Manufacturer	Brand name	SAE viscosity grade	TBN			Comments/material number
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Exxon Mobil Corporation	Mobil Delvac 1 ESP	5W-30		X		
	Mobil Delvac 1 5W-30 Advanced Synthetic	5W-30		X		
	Mobil Delvac 1 LE 5W-30	5W-30			X	
	Mobil Delvac HD 10W-40	10W-40		X		
	Mobil Delvac Ultra 5W-30	5W-30			X	
	Mobil Delvac XHP ESP	10W-40			X	
	Mobil Delvac XHP ESP S	10W-40			X	
	Mobil Delvac XHP ESP 10W-40 V2	10W-40		X		
	Mobil Delvac XHP Ultra LE	5W-30		X		
	Mobil Delvac Modern 10W-40 Advanced Protection	10W-40			X	
	Mobil Delvac Modern 5W-30 Advanced Protection V3	5W-30	X			
	Mobil Delvac Modern 10W-40 Extended Protection Plus	10W-40			X	
	Mobil Delvac Modern 10W-40 Full Protection V4	10W-40		X		
Finke Mineralölwerk GmbH	AVIATICON Finko Super Truck LA Plus	10W-40		X		
	AVIATICON Premium Truck LA Plus 5W-30	5W-30		X		
Fuchs Lubricants Germany GmbH	Titan Cargo FELX LD5W-30	5W-30		X		
	Titan Cargo FELX LD 10W-40	10W-40		X		
Fuchs Petrolub SE	Titan Cargo Maxx	5W-30			X	1)
	Titan Cargo Maxx II	5W-30			X	
	Titan Cargo Maxx	10W-40			X	1) Enhanced corrosion protection
	Titan Cargo Maxx II	10W-40			X	
	Fuchs Titan Cargo LA	10W-40		X		
	Fuchs Titan Cargo LA	10W-40	X			
	PENTOTRUCK ULTRA SAE 10W-30	10W-30	X			

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Multi-grade oils – Category 3.1 (low SAPS oils), SAE grades 5W-30, 10W-30 and 10W-40 for diesel engines						
Manufacturer	Brand name	SAE viscosity grade	TBN			Comments/material number
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Gulf Oil International	Gulf Superfleet ULE	10W-40	X			Enhanced corrosion protection
	Gulf Superfleet Synth ULE	5W-30	X			
	Gulf Superfleet XLE	10W-30	X			
	Gulf Superfleet XLE	10W-40	X			1)
	Gulf Superfleet XLE Plus	10W-40	X			1)
	Gulf Superfleet Synth XLE	10W-30		X		
	Gulf Superfleet Universal	5W-30			X	
	Gulf Superfleet Universal	10W-40			X	
INA Maziva d.o.o.	INA Super 2009 5W-30	5W-30	X			
Kuwait Petroleum Research & Technology	Q8 T 904	10W-40		X		
	Q8 Formula Truck 8900 FE 5W-30	5W-30			X	
MOL-LUB Ltd.	MOL Dynamic Mistral XT 5W-30	5W-30	X			
	MOL Dynamic Mistral 10W-40	10W-40	X			
Motorex AG	Motorex / York Focus QTM	10W-40	X			
	Motorex York Nexus FE SAE 5W-30	5W-30			X	
MPM International Oil Company B.V.	Motor Oil 10w-40 Premium Synthetic Ultra High Performance Diesel	10W-40		X		1)
North Sea Lubricants	Tidal Power Special UHPD 10W-40	10W-40		X		1)
Oel-Brack AG	Midland maxtra	10W-40		X		
OMV Petrol Ofisi A.Ş	Maximus HD-E	5W-30	X			
Orlen Oil	Platinum Ultor Complete	10W-40	X			
Petro-Canada Lubricants Inc.	Duron SHP E6	10W-40		X		
	Duron UHP E6	5W-30			X	
	Duron UHP E6	10W-40			X	
	Duron UHP E6 10W40	10W-40	X			
	Duron UHP E8 5W-30	5W-30			X	
	Duron UHP E8-X 5W-30	5W-30			X	
	Duron UHP E8 10W-40	10W-40			X	
	Duron UHP E8-X 10W-40	10W-40			X	
Repsol Lubricantes y Especialidades, S.A.	REPSOL GIANT 9630 LS-LL	10W-40	X			
	REPSOL GIANT 9660 LS-FE-LL 5W-30	5W-30			X	
	Repsol DieselTurbo VHPD Mid SAPS	5W-30		X		1)
Rowe Mineralölwerk GmbH	Rowe Hightec Truckstar SAE 10W-40 HC-LA	10W-40		X		1)

Multi-grade oils – Category 3.1 (low SAPS oils), SAE grades 5W-30, 10W-30 and 10W-40 for diesel engines						
Manufacturer	Brand name	SAE viscosity grade	TBN			Comments/material number
			8 to 10 mg KOH/g	10 to 12 mg KOH/g	> 12 mg KOH/g	
Shell International Petroleum Company	Shell Fleet Pro CK-4	10W-40			X	
	Shell Rimula K10	10W-40			X	Enhanced corrosion protection
	Shell Rimula K15	5W-30		X		1)
	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	
	Shell Sirius S6 LM	10W-40			X	
SINOPEC Lubricant Co., Ltd.	SINOPEC TULUX T700 Plus	10W-40		X		
SK Enmove Co., Ltd.	ZIC ZS 9000 10W-40	10W-40			X	
	ZIC ZS Ultra 5W-30	5W-30			X	
SRS Schmierstoff Vertrieb GmbH	SRS Cargolub TLA plus	10W-40		X		
	SRS Cargolub TLS plus	5W-30		X		
	SRS Cargolub TLS top	5W-30	X			
	SRS Cargolub Leichtlauf-Motorenöl LA	10W-40		X		
	SRS Leichtlauf-Motorenöl O-1180	10W-40		X		
	SRS Turbo-Rekord top FE	10W-40		X		
	SRS Turbo-Rekord ultra FE	10W-40	X			1)
TotalEnergies Lubrifiant	Rubia Optima 3100 10W-40	10W-40		X		
	Rubia Works 3000 FE 5W-30	5W-30			X	
	Rubia Works 5000 FE 5W-30	5W-30			X	
	Rubia Works 5000 FE 10W-30	10W-30		X		
	Rubia Works 5000 10W-40	10W-40		X		
	Star Max Gen 6 FE 10W-30	10W-30		X		
Transnational Blenders B.V.	Engine Oil Special Synthetic UHPD 10W-40	10W-40		X		1)
Veedol International Limited	VEEDOL MARATRON EXTRA LSP 10W-40	10W-40		X		
Wolf Oil Corporation N.V.	Wolf Officialtech 10W40 Ultra MS	10W-40		X		
	Wolf Officialtech 10W40 UHPD Extra	10W-40		X		
	Wolf Officialtech 10W40 UHPD MS	10W-40		X		
	Wolf Officialtech 10W40 UHPD S	10W-40		X		

Table 83:

7.2 Engine Oils for Two-Cycle Engines

7.2.1 Series-based usability for two-cycle engine oils

Series	Two-cycle engine oil API CF-2			Comments
	Single-grade oils SAE 40	Single-grade oils SAE 50	Multigrade oils 15W-40	
S 53	yes	restricted[1]	restricted[1]	[1]only short term at low temperatures [2]at coolant outlet temp. > 94 °C
S 71	yes	restricted[1]	restricted[2]	
S 92	yes	restricted[1]	restricted[2]	
S 149	yes[2]	yes	no	

Table 84:

7.2.2 Engine oils for two-stroke cycle engines

If the engine oils listed here are not available, two-stroke cycle engine oils may be used, provided they comply with the requirements listed in the table (Engine oil requirements for two-stroke cycle engines, (→ Page 20)).

Other two-stroke cycle engine oils

Manufacturer	Product name	SAE grade & oil category	Comments / material number
Rolls-Royce Solutions America Inc. America	Power Guard® Heavy-duty Diesel Engine Oil for Detroit Diesel 2-Cycle (4X1G) SAE 40	40, API CF-2	4X1 gallons: 23512701
	Power Guard® Heavy-duty Diesel Engine Oil for Detroit Diesel 2-Cycle SAE 40	40, API CF-2	5 gallons: 23512734 55 gallons: 23512702 IBC: 23512739
Chevron	Ursa Extra Duty SAE 40	40	
	Ursa Extra Duty SAE 50	50	
ExxonMobil	Exxon XD-3 Monogrades SAE 40	40	
	Mobile Delvac 1240	40	
	Mobile Delvac 1250	50	
Motorex AG	Motorex Extra SAE 40	40	
Panolin	Extra Diesel DD SAE 40	40	
Shell International Petroleum Company	Shell Rotella DD+40	40	

Table 85:

7.3 Lubricating Greases

7.3.1 Lubricating greases for general applications

For details and special features, see chapter "Lubricating greases" (→ Page 19)

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

Table 86:

8 Approved Coolants

8.1 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" (→ Page 23) and "Unsuitable materials in the coolant circuit" (→ Page 29) in the chapter on "Coolants".

Important

- In the case of an engine coolant circuit with no light metal components 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.
- For Series 4000C01 to C03 and 4000R01 to R03 propylene-glycol-based coolants, only the 40% ready mixture is approved for application.

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

mtu four-stroke cycle engines

X = Application approval

– = No application approval

Series	Application	Coolant system containing light metal	Emulsions See chapter	Coolant without antifreeze See chapter		Antifreeze See chapter				Comments
			8.2	8.3	8.4	8.5	8.6	8.9.1	8.9.2	
099	Marine	Yes	–	X	–	X[1)]	–	–	–	[1)] Not permitted at sea water temperature > 20 °C!
183	Marine	Yes	–	X	–	X[2)]	–	–	–	[2)] Not permitted at sea water temperature > 20 °C!
183	Rail		–	X	–	X	–	–	–	
396	Marine	Yes	–	X	–	X[3)]	–	X[3)]	–	[3)] Not permitted at sea water temperature > 20 °C!

Series	Application	Coolant system containing light metal	Emulsions See chapter	Coolant without antifreeze See chapter		Antifreeze See chapter				Comments
			8.2	8.3	8.4	8.5	8.6	8.9.1	8.9.2	
396TB	Engine-generator set	Yes	–	X	–	X	–	X	–	
	Marine	Yes	–	X	–	X[4)]	–	X[4)]	–	[4)] Not permitted at sea water temperature > 20 °C!
	Rail	Yes	–	X	–	X	–	X	–	
396TC	C&I	Yes	–	X	–	X	–	X	–	
	Engine-generator set	Yes	–	X	–	X	–	X	–	
	Marine	Yes	–	X	–	X[5)]	–	X[5)]	–	[5)] Not permitted at sea water temperature > 20 °C!
	Rail	Yes	–	X	–	X	–	X	–	
396TE	C&I	Yes	–	X	–	X	–	X	–	
	Engine-generator set	Yes	–	X	–	X	–	X	–	
	Marine	Yes	–	X	–	X[6)]	–	X[6)]	–	[6)] Not permitted at sea water temperature > 20 °C!
	Rail	Yes	–	X	–	X	–	X	–	
538	Marine	Yes	X	–	–	–	–	–	–	
595	Marine	Yes	X	–	–	–	–	–	–	
956-01/956-02	Engine-generator set	Yes	X	X	–	X	–	X	–	

Series	Application	Coolant system containing light metal	Emulsions See chapter	Coolant without antifreeze See chapter		Antifreeze See chapter				Comments
			8.2	8.3	8.4	8.5	8.6	8.9.1	8.9.2	
20 V 956TB33	Genset[7)]	Yes	X	–	–	–	–	–	–	[7)] Up to year of manufacture end of 2008, in acc. with identification plate
	Genset[8)]	Yes	–	X	–	X	–	X	–	[8)] From year of manufacture 2009, in acc. with identification plate
12 V/16 V 956TB33	Engine-generator set	Yes	–	X	–	X	–	X	–	
956TB34	Engine-generator set	Yes	–	X	–	X	–	X	–	
1163-02	Engine-generator set	Yes	X	X	–	X	–	X	–	
956-01/956-02	Marine	Yes	X	X	–	–	–	–	–	Heat retention system
1163-02	Marine	Yes	X	X	–	–	–	–	–	
1163-03	Marine	Yes	X[9)]	X[9)]	–	–	–	–	–	When recommissioning/returning to operation, only water-soluble corrosion inhibitor is permitted with approval as per chap. 8.3. [9)] For products, see information in chap. 8.3
1163-04	Marine	Yes	–	X[10)]	–	–	–	–	–	[10)] For products, see information in chap. 8.3

Series	Application	Coolant system containing light metal	Emulsions See chapter	Coolant without antifreeze See chapter		Antifreeze See chapter				Comments
			8.2	8.3	8.4	8.5	8.6	8.9.1	8.9.2	
2000 (incl. model type 07)	Marine	Yes	–	X	–	X[11, 12)]	–	X[11, 12)]	–	[11)] Not permitted at sea water temperature > 25 °C if a heat exchanger is installed on the engine. [12)] Max. admissible antifreeze content limited to 40% by volume
2000 (incl. model type 06)	Engine-generator set	Yes	–	X	–	X	–	X	–	
	C&I	No	–	–	X	–	X	X	X	
	Oil&Gas (S-engines)	No	–	–	X	–	X	X	–	
	Oil&Gas (P-engines)	Yes	–	X	–	X	–	X	–	
4000-01/4000-02/4000-03	C&I	No	–	–	X	–	X	X	X[13)]	[13)] Only a 40% ready mixture may be used.
4000-04 4000-05	C&I	No	–	–	–	–	X[14)]	X	–	[14)] For products, see information in chapter 8.6
4000-01/4000-02/4000-03/4000-04	Engine-generator set	No	–	–	X	–	X[15)]	X	X	[15)] For products, see information in chap. 8.6

Series	Application	Coolant system containing light metal	Emulsions See chapter	Coolant without antifreeze See chapter		Antifreeze See chapter				Comments
			8.2	8.3	8.4	8.5	8.6	8.9.1	8.9.2	
4000-00/4000-01	Marine	Yes	–	X	–	X[16)]	–	X[16)]	–	[16)] Not permitted at sea water temperature > 25 °C if a heat exchanger is installed on the engine.
4000-03	Marine	No	–	–	X	–	X[17)]	X[17)]	X[17)]	[17)] Not permitted at sea water temperature > 25 °C if a heat exchanger is installed on the engine.
4000-U83	Submarine	Yes	–	X	–	X[18)]	–	X[18)]	–	[18)] Not permitted at sea water temperature > 25 °C if a heat exchanger is installed on the engine.
4000-04 4000-05	Marine	No	–	–	X	–	X[19, 20)]	X[19)]	–	[19)] Not permitted at sea water temperature > 25 °C if a heat exchanger is installed on the engine. [20)] For products, see information in chapter 8.6
4000-01	Oil&Gas	Yes: P11, P61, P81, P91	–	X	–	X	–	X	–	

Series	Application	Coolant system containing light metal	Emulsions See chapter	Coolant without antifreeze See chapter		Antifreeze See chapter				Comments
			8.2	8.3	8.4	8.5	8.6	8.9.1	8.9.2	
4000-02/4000-03	Oil&Gas	No	–	–	X	–	X	X	X	
4000-04 4000-05	Oil&Gas	No	–	–	–	–	X[21)]	X	–	[21)] For products, see information in chapter 8.6
4000-00	Rail	Yes	–	X	–	X	–	X	–	
4000-01/4000-02/4000-03	Rail	No	–	–	X	–	X	X	X[22)]	In the case of engines with no light metal components but with an external cooling system containing light metal, the coolant approvals for cooling systems containing light metal shall apply. [22)] Only a 40% ready mixture may be used.

Series	Applicati-on	Coolant system containing light metal	Emul-sions See chap-ter	Coolant wi-thout antifree-ze See chapter		Antifreeze See chapter				Comments
			8.2	8.3	8.4	8.5	8.6	8.9.1	8.9.2	
4000-04	Rail	No	–	–	–	–	X[23)]	X	–	In the case of engines with no light metal compo-nents but with an ex-ternal coo-ling system containing light metal, the coolant approvals for cooling systems containing light metal shall apply. [23)] For pro-ducts, see information in chapter 8.6
8000	Marine	Yes	–	X	–	–	–	–	–	

Table 87:

Detroit Diesel four-stroke cycle and two-stroke cycle engines

X = Application approval

– = No application approval

Series	Application	Coolant system containing light metal	Emulsions See chapter	Coolant without antifreeze See chapter		Antifreeze See chapter		Comments
			8.2	8.7.1/ 8.7.2	8.8.1/ 8.8.2	8.7.3/ 8.7.4	8.8.3/ 8.8.4	
S60	Marine		–	X	–	X	–	Four-stroke cycle engines
S53	Marine C&I Engine-generator set	No	–	–	X	–	X	Two-stroke cycle engines
S71		No	–	–	X	–	X	Two-stroke cycle engines
S92		No	–	–	X	–	X	Two-stroke cycle engines
S149		No	–	–	X	–	X	Two-stroke cycle engines

Table 88:

8.2 Emulsifiable corrosion inhibitor oils

For details and special features, see chapter on “Coolants" (→ Page 23)

Emulsifiable corrosion inhibitor oils

Manufacturer	Brand name	Runtime Hours / Years	Comments / Material number
Quaker Houghton	Oil 9156	6000 / 1	X00056748 (barrel) X00056749 (canister)

Table 89:

8.3 Coolants without antifreeze for cooling systems containing light metal

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

For details and special properties, see the chapter on "Coolants" (→ Page 23).

Important
For Series 1163-03 and 1163-04 marine engines, only coolants marked with an asterisk * in the product/ brand name may be used.

Coolant without antifreeze – Concentrates

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant CS100 Corrosion Inhibitor Concentrate*		X					X	6000/2	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
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	
Fuchs SE	Fricofin ME*		X					X	6000/2	
Old World Industries Inc.	Final Charge Extended Life Corrosion Inhibitor (A 216)	X				X			6000/2	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Valvoline	ZEREX G93*		X					X	6000/2	
	OEM Advanced 93*		X					X	6000/2	
YORK SAS	York 719*		X					X	6000/2	

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

For details and special properties, see the chapter on "Coolants" (→ Page 23).

Important
For Series 1163-03 and 1163-04 marine engines, only coolants marked with an asterisk * in the product name may be used.

Coolant without antifreeze – Ready mixtures

Manufacturer	Product name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant CS10/90 Corrosion Inhibitor Premix*		X					X	6000/2	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Penske Power Systems	PowerCool Pyroshield-GF Coolant	X				X			6000/2	
Recochem Inc.	HD Expert™ Endurance WB Prediluted Coolant	X				X			6000/2	

8.4 Coolants without antifreeze for cooling systems free of light metal

8.4.1 Coolant without antifreeze – Concentrates for cooling systems not containing light metal

For details and special properties, see the chapter on "Coolants" (→ Page 23).

Coolant without antifreeze – Concentrates

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant CS100 Corrosion Inhibitor Concentrate		X					X	6000/2	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
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.
Arteco NV	Havoline XLI	X						X	6000/2	
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)
Chevron	Delo XLI Corrosion Inhibitor - Concentrate	X						X	6000/2	
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	
Fuchs SE	Fricofin ME		X					X	6000/2	
ImproChem	COOL-18		X	X			X		6000/2	
Nalco Water An Ecolab Company	Alfloc™ 3477	X						X	6000/2	
	Nalcool® 2000		X	X			X		6000/2	
Old World Industries Inc.	Final Charge Extended Life Corrosion Inhibitor (A 216)	X				X			6000/2	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Total Lubrifiants	Total WT Supra	X						X	6000/2	
Valvoline	Zerex G93		X					X	6000/2	
	OEM Advanced 93		X					X	6000/2	
YORK SAS	York 719		X					X	6000/2	

8.4.2 Coolant without antifreeze – Ready mixtures for cooling systems not containing light metal

For details and special properties, see the chapter on "Coolants" (→ Page 23)

Coolant without antifreeze – Ready mixtures

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant CS 10/90 Corrosion Inhibitor Premix		X					X	6000/2	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Nalco Water An Ecolab Company	Alfloc ™ 3443 (7%)	X						X	6000/2	
Penske Power Systems	PowerCool Pyroshield-GF Coolant	X				X			6000/2	
Recochem Inc.	HD Expert™ Endurance WB Prediluted Coolant	X				X			6000/2	

8.5 Antifreezes for cooling systems containing light metal

8.5.1 Antifreeze – Concentrates for cooling systems containing light metal

For details and special properties, see the chapter on "Coolants" (→ Page 23).

Antifreeze – Concentrates

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AO 100 Antifreeze Concentrate	X							9000/3	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 100 Antifreeze Concentrate	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Avia AG	Antifreeze APN - S	X							9000/3	
BASF SE	Glysantin G05		X	X			X		9000/5	
	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	
BayWa AG	Tectrol Coolprotect	X	X				X	X	9000/5	
Castrol	Castrol Radicool NF	X	X				X	X	9000/5	
CCI Corporation	L 415	X				X			9000/3	
Classic Schmierstoff GmbH & Co. KG	Classic Kolda UE G30®	X							9000/3	
COPARTS Autoteile GmbH	CAR1 premium long-life C48 antifreeze	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	
	Power Cool Diesel Engine Coolant		X	X					9000/3	
Drew Marine	Drewgard ZX	X							9000/3	

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Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
ExxonMobil	Mobil Delvac Extended Life Coolant	X				X			9000/3	
	Mobil Heavy Duty Coolant		X	X					9000/3	
	Mobil Mining Coolant		X	X					9000/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30	X							9000/3	
	AVIATICON Finkofreeze F48	X	X				X	X	9000/5	
Fuchs SE	Fricofin	X	X				X	X	9000/5	
	Fricofin G12	X							9000/3	
Krafft S.L.U.	Refrigerante ACU 2300		X	X			X		9000/3	X00058075 (barrel)
LAEMMLE Chemicals AG	ROXOR ANTI-FROST MT-325	X	X				X	X	9000/5	
Mitan Mineralöl GmbH	Alpine C30	X							9000/3	
	Alpine C48	X	X				X	X	9000/5	
MJL Banglasdesh Ltd.	Omera Premium Coolant	X							9000/3	
Moove Lubricants Limited	Mobil Antifreeze Extra	X	X				X	X	9000/5	
Motorex AG	Motorex Coolant G48	X	X				X	X	9000/5	
Nalco Water An Ecolab 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	
	Fleet Charge SCA Precharged Coolant / Antifreeze		X	X					9000/3	
	Final Charge Global Extended Life Coolant Antifreeze	X				X			9000/3	
	Peak Heavy Duty Coolant		X	X					9000/3	
Penske Power Systems	Power Cool - HB500	X	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 Lubrifiants	Glacelf MDX	X	X				X	X	9000/5	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Valvoline	Zerex G05		X	X			X		9000/5	
	Zerex G48	X	X				X	X	9000/5	
	Zerex G30	X							9000/3	
	OEM Advanced 05		X	X			X		9000/5	
	OEM Advanced 30	X							9000/3	
	OEM Advanced 48	X	X				X	X	9000/5	
Volvo Trucks	Road Choice Nitrite-Free OAT Extended Life Coo-lant	X				X			9000/3	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A30	X							9000/3	
	Hoyer Freeze A48	X	X				X	X	9000/5	

Table 90:

8.5.2 Antifreeze – Ready mixtures for cooling systems containing light metal

For details and special properties, see the chapter on "Coolants" (→ Page 23).

Important
For model type 00 to 07 Series 2000 marine engines, only coolants marked with an asterisk * in the product/ brand name may be used.

Ready mixtures for cooling systems containing light metal

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AH 35/65 Antifreeze Premix*	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 40/60 Antifreeze Premix*	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 50/50 Antifreeze Premix	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Rolls-Royce Solutions America Inc.	Power Cool® Universal 35/65 mix*	X	X				X	X	9000/5	800085 (5 gallons) 800086 (55 gallons)
	Power Cool® Universal 50/50 mix	X	X				X	X	9000/5	800071 (5 gallons) 800084 (55 gallons)
	Power Cool® Off-Highway Coolant 50/50 Premix		X	X			X		9000/5	23533531 (5 gallons) 23533532 (55 gallons)
A. Roth GmbH & Co KG	CRO Coolant Plus -25 °C Ready*	X							9000/3	
BayWa AG	Tectrol Coolprotect Mix 3000*	X							9000/3	Antifreeze protection down to -24 °C
BASF SE	Glysantin G30 RM/50 ECO pink BMB 100	X							9000/3	
Castrol	Castrol Radicool NF Premix (45 %)	X	X				X	X	9000/5	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
CCI Corporation	L 415 (50 %)	X				X			9000/3	
Cepsa Comercial Petróleo S.A.U.	XTAR Super Coolant Hybrid NF 50%	X	X				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	
	Power Cool Prediluted 50/50 Diesel Engine Coolant		X	X					9000/3	
Exxon Mobil	Mobil Delvac Extended Life Prediluted Coolant (50/50)	X				X			9000/3	
	Mobile Heavy Duty 50/50 Prediluted Coolant		X	X					9000/3	
	Mobile Mining 50/50 Prediluted Coolant		X	X					9000/3	
Fast Chemical SRL	Fast Coolant G30 50%	X							9000/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F48 RM 50/50	X	X				X	X	9000/5	
	AVIATICON Finkofreeze F30 RM 40:60 +*	X							9000/3	
Friedrich Scharr KG	Unil Metis RTU GC-26*	X							9000/3	
Fuchs SE	Fricofin 50	X	X				X	X	9000/5	
Moove Lubricants Limited	Mobil Coolant Extra Ready -36 °C	X	X				X	X	9000/5	
Motorex AG	Motorex Coolant G48 Ready to use (50/50)	X	X				X	X	9000/5	
Navistar Inc.	Fleetrite 50/50 Prediluted Nitrite-Free Life Coolant	X				X			9000/3	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)	X				X			9000/3	
	Final Charge Global Extended Life Prediluted Coolant/Antifreeze (50/50)	X				X			9000/3	
	Fleet Charge SCA Precharged 50/50 Prediluted Coolant		X	X					9000/3	
Penske Power Systems	Power Cool - HB500 Premix 35/65*	X	X				X		9000/3	
	Power Cool - HB500 Premix 50/50	X	X				X		9000/3	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Raloy Lubricantes	Antifreez Long Life NF-300 Ready-to-Use (50:50)	X	X				X	X	9000/5	
Recochem	HD Expert ™ Endurance 50-50 Prediluted	X				X			9000/3	
	R 542 35/65*	X	X				X		9000/3	
Total Lubrifiants	Coolelf MDX -26 °C*	X	X				X	X	9000/5	
	Coolelf MDX -37 °C	X	X				X	X	9000/5	
Valvoline	Zerex G05 50/50 Mix		X	X			X		9000/5	
	Zerex G48 premix 50%	X	X				X	X	9000/5	
	OEM Advanced 48 pre-mix 50%	X	X				X	X	9000/5	
Volvo Trucks	Road Choice 50/50 Pre-diluted Nitrite-Free OAT Extended Life Coolant	X				X			9000/3	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A30 RM 40:60*	X							9000/3	
	Hoyer Freeze A48 RM 50:50	X	X				X	X	9000/5	
YPF S.A. Argentina	Kriox MTL50	X				X			9000/3	

Table 91:

8.6 Antifreezes for cooling systems free of light metal

8.6.1 Antifreeze – Concentrates for cooling systems free of light metal

For details and special properties, see the chapter on "Coolants" (→ Page 23)

Important
For Series 4000-04 (except engine-generator set) and 4000-05, only coolants marked with an asterisk * in the product/brand name may be used.

Antifreeze – Concentrates

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AO 100* Antifreeze Concentrate	X							9000/3	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 100* Antifreeze Concentrate	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Arteco NV	Havoline XLC (1040112)	X						X	9000/3	
Avia AG	Antifreeze APN - S*	X							9000/3	
BASF SE	Glysantin G05		X	X			X		9000/5	
	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	
BayWa AG	Tectrol Coolprotect*	X	X				X	X	9000/5	
Castrol	Castrol Radicool NF*	X	X				X	X	9000/5	
Classic Schmierstoff GmbH & Co. KG	Classic Kolda UE G30®*	X							9000/3	
CCI Corporation	L415*	X				X			9000/3	
Chevron	Delo XLC Antifreeze/ Coolant-Concentrate	X						X	9000/3	
COPARTS Autoteile GmbH	CAR1 Premium Longlife Kühlerschutz C48*	X	X				X	X	9000/5	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Daimler Trucks North America	Alliance OAT Extended Life Coolant*	X				X			9000/3	
Detroit Diesel Corp.	Power Cool Plus Coolant*	X				X			9000/3	
	Power Cool Diesel Engine Coolant		X	X					9000/3	
Drew Marine	Drewgard ZX*	X							9000/3	
ExxonMobil	Mobil Delvac Extended Life Coolant*	X				X			9000/3	
	Mobil Heavy Duty Coolant		X	X					9000/3	
	Mobil Mining Coolant		X	X					9000/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30*	X							9000/3	
	AVIATICON Finkofreeze F48*	X	X				X	X	9000/5	
Fuchs SE	Fricofin*	X	X				X	X	9000/5	
	Fricofin G12 Plus*	X							9000/3	
	Fricofin LL	X						X	9000/3	
Krafft S.L.U.	Refrigerante ACU 2300		X	X			X		9000/3	X00058075 (barrel)
Kuwait Petroleum Research & Technology BV	Q8 Mahler Cool	X						X	9000/3	
LAEMMLE Chemicals AG	ROXOR ANTI-FROST MT-325*	X	X				X	X	9000/5	
Mitan Mineralöl GmbH	Alpine C30*	X							9000/3	
	Alpine C48*	X	X				X	X	9000/5	
MJL Bangladesh	Omera Premium Coolant*	X							9000/3	
Moove Lubricants Limited	Mobil Antifreeze Extra*	X	X				X	X	9000/5	
Motorex AG	Motorex Coolant G48*	X	X				X	X	9000/5	
Nalco Water An Ecolab Company	Nalcool NF 48 C*	X	X				X	X	9000/5	
Navistar Inc.	Fleetrite Nitrite-Free Extended Life Coolant*	X				X			9000/3	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Coolant*	X				X			9000/3	
	Fleetcharge SCA Pre-charged Coolant / Anti-freeze		X	X					9000/3	
	Final Charge Global Extended Life Coolant Anti-freeze*	X				X			9000/3	
	Peak Heavy Duty Coolant		X	X					9000/3	
Penske Power Systems	Power Cool - HB500	X	X				X		9000/3	
	Power Cool - HB800	X	X	X			X		9000/3	
Puma Energy International S.A.	Puma HD XLC 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	
	R824M	X	X	X			X		9000/3	
Total Lubrifiants	Glacelf Auto Supra	X						X	9000/3	
	Glacelf MDX*	X	X				X	X	9000/5	
	Glacelf Supra	X						X	9000/3	
Valvoline	Zerex G05		X	X			X		9000/5	
	Zerex G30*	X							9000/3	
	Zerex G48*	X	X				X	X	9000/5	
	OEM Advanced 05		X	X			X		9000/5	
	OEM Advanced 30*	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	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A30*	X							9000/3	
	Hoyer Freeze A48*	X	X				X	X	9000/5	

Table 92:

8.6.2 Antifreeze – Ready mixtures for cooling systems free of light metal

For details and special properties, see the chapter on "Coolants" (→ Page 23)

Important

For Series 4000-04 (except engine-generator set) and 4000-05, only coolants marked with an asterisk * in the product/brand name may be used.

Ready mixtures for cooling systems free of light metal

Manufacturer	Brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AH 35/65 Antifreeze Premix*	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 40/60 Antifreeze Premix*	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 50/50 Antifreeze Premix*	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Rolls-Royce Solutions America Inc.	Power Cool® Universal 35/65 mix*	X	X				X	X	9000/5	800085 (5 gallons) 800086 (55 gallons)
	Power Cool® Universal 50/50 mix*	X	X				X	X	9000/5	800071 (5 gallons) 800084 (55 gallons)
	Power Cool® Off-Highway Coolant 50/50 Premix		X	X			X		9000/5	23533531 (5 gallons) 23533532 (55 gallons)
A. Roth GmbH & Co KG	CRO Coolant Plus -25 °C Ready*	X							9000/3	

Manufacturer	Brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Arteco NV	Halvoline XLC Pre-mixed 50/50 (1033073)	X						X	9000/3	
	Halvoline XLC Pre-mixed 40/60 (1033069)	X						X	9000/3	
	Halvoline XLC + B2 35/65 (OF13) (2000214)	X						X	9000/3	
BASF SE	Glysantin G30 RM/50 ECO pink BMB 100*	X							9000/3	
BayWa AG	Tectrol Coolprotect Mix 3000*	X							9000/3	Antifreeze protection down to -24 °C
Castrol	Castrol Radicool NF Premix (45 %)*	X	X				X	X	9000/5	
CCI Corporation	L 415 (50 %)*	X				X			9000/3	
Cepsa Comercial Petróleo S.A.U.	Xtar Super Coolant Hybrid NF 50%*	X	X				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	
	Power Cool Prediluted 50/50 Diesel Engine Coolant		X	X					9000/3	
ExxonMobil	Mobil Delvac Extended Life Prediluted Coolant (50/50)*	X				X			9000/3	
	Mobile Heavy Duty 50/50 Prediluted Coolant		X	X					9000/3	
	Mobile Mining 50/50 Prediluted Coolant		X	X					9000/3	
Fast Chemical SRL	Fast Coolant G30 50%*	X							9000/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F48 RM 50/50*	X	X				X	X	9000/5	
	AVIATICON Finkofreeze F30 RM 40:60 +*	X							9000/3	
Friedrich Scharr KG	Unil Metis RTU GC-26*	X							9000/3	
Fuchs SE	Fricofin 50*	X	X				X	X	9000/5	
	Fricofin LL 50	X						X	9000/3	
Kuwait Petroleum Research & Technology BV	Q8 Mahler Cool premixed 4060	X						X	9000/3	
Moove Lubricants Limited	Mobil Coolant Extra Ready Mixed -36 °C*	X	X				X	X	9000/5	
Motorex AG	Motorex Coolant G48*	X	X				X	X	9000/5	

Manufacturer	Brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Navistar Inc.	Fleetrite 50/50 Prediluted Nitrite-Free Extended Life Coolant*	X				X			9000/3	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)*	X				X			9000/3	
	Final Charge Global Extended Life Predilluted Coolant / Antifreeze (50/50)*	X				X			9000/3	
	Fleet Charge SCA Precharged 50/50 Prediluted Coolant		X	X					9000/3	
Penske Power Systems	Power Cool - HB500 Premix 50/50	X	X				X		9000/3	
	Power Cool - HB500 35/65	X	X				X		9000/3	
	Power Cool - HB800 Premix 50/50	X	X	X			X		9000/3	
	Power Cool - HB800 35/65	X	X	X			X		9000/3	
Puma Energy International S.A.	Puma HD XLP Coolant	X						X	9000/3	50% premix
Raloy Lubricantes	Antifreeze Long Life NF-300 Ready-to-Use (50:50)*	X	X				X	X	9000/5	
Recochem	HD Expert ™ Endurance 50-50 Prediluted*	X				X			9000/3	
	R542 35/65	X	X				X		9000/3	
	Turbo Power R824 M 35/65	X	X	X			X		9000/3	
Total Lubrifiants	Coolelf Auto Supra -26 °C	X						X	9000/3	40/60 premix
	Coolelf Auto Supra -37 °C	X						X	9000/3	50/50 premix
	Coolelf MDX -26 °C*	X	X				X	X	9000/5	
	Coolelf MDX -37 °C*	X	X				X	X	9000/5	
	Coolelf Supra (40 %)	X						X	9000/3	
	Coolelf Supra GF NP (50 %)	X						X	9000/3	
Valvoline	Zerex G05 50/50 Mix		X	X			X		9000/5	
	Zerex G48 premix 50%*	X	X				X	X	9000/5	
	OEM Advanced 48 premix 50%*	X	X				X	X	9000/5	

Manufacturer	Brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Volvo Trucks	Road Choice 50/50 Pre-diluted Nitrite-Free OAT Extended Life Coolant*	X				X			9000/3	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A30 RM 40:60*	X							9000/3	
	Hoyer Freeze A48 RM 50:50*	X	X				X	X	9000/5	
YPF S.A. Argentina	Kriox MTL50*	X				X			9000/3	

Table 93:

8.7 Coolant Additives for Series 60 Engines

8.7.1 Coolant without antifreeze – Concentrates for Series 60 engines

For details and special properties, see the chapter on "Coolants" (→ Page 23)

Coolant without antifreeze – Concentrates

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant CS100 Corrosion Inhibitor Concentrate		X					X	6000/2	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
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)
Drew Marine	Drewgard XTA		X					X	6000/2	
Fuchs SE	Fricofin ME		X					X	6000/2	
Valvoline	ZEREX G93		X					X	6000/2	
	OEM Advanced 93		X					X	6000/2	
YORK SAS	York 719		X					X	6000/2	

Table 94:

8.7.2 Coolant without antifreeze – Ready mixtures for Series 60 engines

For details and special properties, see chapter on “Coolants” (→ Page 23)

Coolant without antifreeze, ready mixtures

Manufacturer	Product name	Inhibitors							Runtime Hours/Years	Comments/ Material number
		Organic	Silicone	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant CS 10/90 Corrosion Inhibitor Premix		X					X	6000 / 2	No longer included in portfolio. Remaining stocks of this product can be used up as long as the shelf life has not expired.

Table 95:

8.7.3 Antifreeze – Concentrates for Series 60 engines

For details and special properties, see the chapter on "Coolants" (→ Page 23)

Antifreeze – Concentrates

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AO100 Antifreeze Concentrate	X							9000/3	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH100 Antifreeze Concentrate	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Avia AG	Antifreeze APN - S	X							9000/3	
BASF SE	Glysantin G05		X	X			X		9000/5	
	Glysantin G30 pink	X							9000/3	X00058072 (canister) X00058071 (barrel)
	Glysantin G48 blue green	X	X				X	X	9000/5	X00058054 (25 l) X00058053 (210 l)
	Glysantin G30 ECO pink BMB 100	X							9000/3	
BayWa AG	Tectrol Coolprotect	X	X				X	X	9000/5	
Castrol	Castrol Radicool NF	X	X				X	X	9000/5	
CCI Corporation	L 415	X				X			9000/3	
Classic Schmierstoff GmbH & Co. KG	Classic Kolda UE G30®	X							9000/3	
COPARTS Autoteile GmbH	CAR1 Premium Longlife Kühlerschutz C48	X	X				X	X	9000/5	
Daimler Trucks Norh America	Alliance OAT Extended Life Coolant	X				X			9000/3	
Detroit Diesel Corp.	Power Cool Plus Coolant	X				X			9000/3	
	Power Cool Diesel Engine Coolant		X	X					9000/3	
Drew Marine	Drewgard ZX	X							9000/3	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
ExxonMobil	Mobil Delvac Extended Life Coolant	X				X			9000/3	
	Mobil Heavy Duty Coolant		X	X					9000/3	
	Mobil Mining Coolant		X	X					9000/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30	X							9000/3	
	AVIATICON Finkofreeze F48	X	X				X	X	9000/5	
Fuchs SE	Fricofin	X	X				X	X	9000/5	
	Fricofin G12 Plus	X							9000/3	
LAEMMLE Chemicals AG	ROXOR ANTI-FROST MT-325	X	X				X	X	9000/5	
Mitan Mineralöl GmbH	Alpine C30	X							9000/3	
	Alpine C48	X	X				X	X	9000/5	
MJL Bangladesh Ltd.	Omera Premium Coolant	X							9000/3	
Motorex AG	Motorex Coolant G48	X	X				X	X	9000/5	
Moove Lubricants Limited	Mobil Antifreeze Extra	X	X				X	X	9000/5	
Nalco Water An Ecolab 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	
	Fleet Charge SCA Precharged Coolant / Antifreeze		X	X					9000/3	
	Final Charge Global Extended Life Coolant / Antifreeze	X				X			9000/3	
	Peak Heavy Duty Coolant		X	X					9000/3	
Penske Power Systems	Power - Cool HB500	X	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	
	R 542	X	X				X		9000/3	
Total Lubrifiants	Glacelf MDX	X	X				X	X	9000/5	

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Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Valvoline	Zerex G05		X	X			X		9000/5	
	Zerex G48	X	X				X	X	9000/5	
	Zerex G30	X							9000/3	
	OEM Advanced 05		X	X			X		9000/5	
	OEM Advanced 30	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	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A30	X							9000/3	
	Hoyer Freeze A48	X	X				X	X	9000/5	

Table 96:

8.7.4 Antifreeze – Ready mixtures for Series 60 engines

For details and special properties, see the chapter on "Coolants" (→ Page 23)

Ready mixtures for Series 60 engines

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AH 35/65 Antifreeze Premix	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 40/60 Antifreeze Premix	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 50/50 Antifreeze Premix	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Rolls-Royce Solutions America Inc.	Power Cool® Universal (35/65)	X	X				X	X	9000/5	800085 (5 gallons) 800086 (55 gallons)
	Power Cool® Universal (50/50)	X	X				X	X	9000/5	800069 (1 gallon) 800071 (5 gallons) 800084 (55 gallons)
	Power Cool® Off Highway 50/50		X	X			X		9000/5	23533530 (1 gallon) 23533531 (5 gallons) 23533532 (55 gallons)
A. Roth GmbH & Co KG	CRO Coolant Plus -25 °C Ready	X							9000/3	
BASF SE	Glysantin G30 RM/50 ECO pink BMB 100	X							9000/3	
BayWa AG	Tectrol Coolprotect Mix 3000	X							9000/3	Antifreeze protection down to -24 °C

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Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Castrol	Castrol Radicool NF Premix (45%)	X	X				X	X	9000/5	
CCI Corporation	L 415 (50%)	X				X			9000/3	
Cepsa Comercial Petróleo S.A.U.	XTAR Super Coolant Hybrid NF 50%	X	X				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	
	Power Cool Prediluted 50/50 Diesel Engine Coolant		X	X					9000/3	
ExxonMobil	Mobil Delvac Extended Life Prediluted Coolant (50/50)	X				X			9000/3	
	Mobile Heavy Duty 50/50 Prediluted Coolant		X	X					9000/3	
	Mobile Mining 50/50 Prediluted Coolant		X	X					9000/3	
Fast Chemical SRL	Fast Coolant G30 50%	X							9000/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F48 RM 50/50	X	X				X	X	9000/5	
	AVIATICON Finkofreeze F30 RM 40:60 +	X							9000/3	
Friedrich Scharr KG	Unil Metis RTU GC-26	X							9000/3	
Fuchs SE	Fricofin 50	X	X				X	X	9000/5	
Moove Lubricants Limited	Mobil Coolant Extra Ready Mixed -36 °C	X	X				X	X	9000/5	
Motorex AG	Motorex Coolant G48 Ready to use (50/50)	X	X				X	X	9000/5	
Navistar Inc.	Fleetrite 50/50 Prediluted Nitrite-Free Extended Life Coolant	X				X			9000/3	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)	X				X			9000/3	
	Final Charge Global Extended Life Prediluted Coolant/Antifreeze (50/50)	X				X			9000/3	
	Fleet Charge SCA Precharged 50/50 Prediluted Coolant		X	X					9000/3	
Penske Power Systems	Power Cool - HB500 Premix 50/50	X	X				X		9000/3	
	Power Cool - HB 500 35/65	X	X				X		9000/3	
Raloy Lubricantes	Antifreeze Long Life NF-300 Ready-to-Use (50:50)	X	X				X	X	9000/5	
Recochem	HD Expert™ Endurance 50-50 Prediluted	X				X			9000/3	
	R 542 35/65	X	X				X		9000/3	
Total Lubrifiants	Coolelf MDX -26 °C	X	X				X	X	9000/5	
	Coolelf MDX -37 °C	X	X				X	X	9000/5	
Valvoline	Zerex G05 50/50 Mix		X	X			X		9000/5	
	Zerex G48 premix 50%	X	X				X	X	9000/5	
	OEM Advanced 48 premix 50%	X	X				X	X	9000/5	
Volvo Trucks	Road Choice 50/50 Prediluted Nitrite-Free OAT Extended Life Coolant	X				X			9000/3	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A30 RM 40:60	X							9000/3	
	Hoyer Freeze A48 RM 50:50	X	X				X	X	9000/5	
YPF S.A. Argentina	Kriox MTL 50	X				X			9000/3	

Table 97:

8.8 Coolant Additives for Two-Cycle Engines

8.8.1 Coolant without antifreeze – Concentrates for two-stroke cycle engines

For details and special properties, see the chapter on "Coolants" (→ Page 23)

Coolant without antifreeze – Concentrates

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant CS100 Corrosion Inhibitor Concentrate		X					X	6000/2	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Rolls-Royce Solutions America Inc.	Power Cool® Plus 6000 Concentrate		X					X	6000/2	Colored green 23533527 (1 gallon) 23533526 (5 gallons)
BASF SE	Glysacorr G93 green		X					X	6000/2	X00058062 (canister) X00054105 (barrel)
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	
Fuchs SE	Fricofin ME		X					X	6000/2	
Old World Industries Inc.	Final Charge Extended Life Corrosion Inhibitor (A 216)	X				X			6000/2	
Valvoline	Zerex G93		X					X	6000/2	
	OEM Advanced 93		X					X	6000/2	
YORK SAS	York 719		X					X	6000/2	

Table 98:

8.8.2 Coolant without antifreeze – Ready mixtures for two-stroke cycle engines

For details and special properties, see the chapter on "Coolants" (→ Page 23)

Coolant without antifreeze – Ready mixtures

Manufacturer	Product name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant CS 10/90 Corrosion Inhibitor Premix		X					X	6000/2	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Penske Power Systems	PowerCool Pyroshield-GF Coolant	X				X			6000/2	
Recochem Inc.	HD Expert™ Endurance WB Prediluted Coolant	X				X			6000/2	

Table 99:

8.8.3 Antifreeze – Concentrates for two-stroke cycle engines

For details and special properties, see the chapter on "Coolants" (→ Page 23)

Antifreeze – Concentrates

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AO 100 Antifreeze Concentrate	X							9000/3	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 100 Antifreeze Concentrate	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Rolls-Royce Solutions America Inc.	Power Cool® 3149	X		X					9000/5	23528572 23528571
Avia AG	Antifreeze APN - S	X							9000/3	
BASF SE	Glysantin G30 pink	X							9000/3	X00058072 (canister) X00058071 (barrel)
	Glysantin G30 ECO pink BMB 100	X							9000/3	
	Glysantin G48 blue green	X	X				X	X	9000/5	X00058054 (25 l) X00058053 (210 l)
BayWa AG	Tectrol Coolprotect	X	X				X	X	9000/5	
Castrol	Castrol Radicool NF	X	X				X	X	9000/5	
CCI Corpration	L 415	X				X			9000/3	
Classic Schmierstoff GmbH & Co. KG	Classic Kolda UE G30®	X							9000/3	
COPARTS Autoteile GmbH	CAR1 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	
	Power Cool Diesel Engine Coolant		X	X					9000/3	
Drew Marine	Drewgard ZX	X							9000/3	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Exxon Mobil	Mobil Delvac Extended Life Coolant	X				X			9000/3	
	Mobil Heavy Duty Coolant		X	X					9000/3	
	Mobil Mining Coolant		X	X					9000/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30	X							9000/3	
	AVIATICON Finkofreeze F48	X	X				X	X	9000/5	
Fuchs SE	Fricofin	X	X				X	X	9000/5	
	Fricofin G12 Plus	X							9000/3	
LAEMMLE Chemicals AG	ROXOR ANTI-FROST MT-325	X	X				X	X	9000/5	
Mitan Mineralöl GmbH	Alpine C30	X							9000/3	
	Alpine C48	X	X				X	X	9000/5	
MJL Bangladesh	Omera Premium Coolant	X							9000/3	
Moove Lubricants Limited	Mobil Antifreeze Extra	X	X				X	X	9000/5	
Motorex AG	Motorex Coolant G48	X	X				X	X	9000/5	
Nalco Water An Ecolab 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	
	Fleet Charge SCA Precharged Coolant / Antifreeze		X	X					9000/3	
	Final Charge Global Extended Life Coolant / Antifreeze	X				X			9000/3	
	Peak Heavy Duty Coolant		X	X					9000/3	
Penske Power Systems	Power Cool - HB500	X	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	
	R 542	X	X				X		9000/3	
Total Lubrifiants	Glacelf MDX	X	X				X	X	9000/5	

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Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Valvoline	Zerex G30	X							9000/3	
	Zerex G48	X	X				X	X	9000/5	
	OEM Advanced 30	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	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A30	X							9000/3	
	Hoyer Freeze A48	X	X				X	X	9000/5	

Table 100:

8.8.4 Antifreeze – Ready mixtures for two-stroke cycle engines

For details and special properties, see the chapter on "Coolants" (→ Page 23)

Ready mixtures for two-stroke cycle engines

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AH 35/65 Antifreeze Premix	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH40/60 Antifreeze Premix	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AH 50/50 Antifreeze Premix	X	X				X	X	9000/5	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
Rolls-Royce Solutions America Inc.	Power Cool® Universal 35/65 mix	X	X				X	X	9000/5	800085 (5 gallons) 800086 (55 gallons)
	Power Cool® Universal 50/50 mix	X	X				X	X	9000/5	800071 (5 gallons) 800084 (55 gallons)
A. Roth GmbH & Co KG	CRO Coolant Plus -25 °C Ready	X							9000/3	
BASF SE	Glysantin G30 RM/50 ECO pink BMB 100	X							9000/3	
BayWa AG	Tectrol Coolprotect Mix 3000	X							9000/3	Antifreeze protection down to -24 °C
Castrol	Castrol Radicool NF Premix (45 %)	X	X				X	X	9000/5	
CCI Corporation	L 415 (50 %)	X				X			9000/3	
Cepsa Comercial Petróleo S.A.U.	XTAR Super Coolant Hybrid NF 50%	X	X				X	X	9000/5	
Daimler Trucks North America	Alliance 50/50 Prediluted OAT Extended Life Coolant	X				X			9000/3	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Detroit Diesel Corp.	Power Cool Plus Prediluted Coolant (50/50)	X				X			9000/3	
	Power Cool Prediluted 50/50 Diesel Engine Coolant		X	X					9000/3	
ExxonMobil	Mobil Delvac Extended Life Prediluted Coolant (50/50)	X				X			9000/3	
	Mobile Heavy Duty 50/50 Prediluted Coolant		X	X					9000/3	
	Mobile Mining 50/50 Prediluted Coolant		X	X					9000/3	
Fast Chemical SRL	Fast Coolant G30 50%	X							9000/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F48 RM 50/50	X	X				X	X	9000/5	
	AVIATICON Finkofreeze F30 RM 40:60 +	X							9000/3	
Fiedrich Scharr KG	Unil Metis RTU GC-26	X							9000/3	
Fuchs SE	Fricofin 50	X	X				X	X	9000/5	
Motorex AG	Motorex Coolant G48 Ready to use (50/50)	X	X				X	X	9000/5	
Moove Lubricants Limited	Mobil Coolant Extra Ready Mixed -36 °C	X	X				X	X	9000/5	
Navistar Inc.	Fleetrite 50/50 Prediluted Nitrite-Free Extended Life Coolant	X				X			9000/3	
Penske Power Systems	Power Cool - HB500 Premix 35/65	X	X				X		9000/3	
	Power Cool - HB500 Premix 50/50	X	X				X		9000/3	
Raloy Lubricantes	Antifreeze Long Life NF-300 Ready-to-Use (50:50)	X	X				X	X	9000/5	
Recochem	HD Expert ™ Endurance 50-50 Prediluted	X				X			9000/3	
	R 542 35/65	X	X				X		9000/3	

Manufacturer	Product/brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)	X				X			9000/3	
	Final Charge Global Extended Life Prediluted Coolant / Antifreeze (50/50)	X				X			9000/3	
	Fleet Charge SCA Precharged 50/50 Prediluted Coolant		X	X					9000/3	
Total Lubrifiants	Coolelf MDX -26 °C	X	X				X	X	9000/5	
	Coolelf MDX -37 °C	X	X				X	X	9000/5	
Valvoline	Zerex G48 premix 50%	X	X				X	X	9000/5	
	OEM Advanced 48 premix 50%	X	X				X	X	9000/5	
Volvo Trucks	Road Choice 50/50 Prediluted Nitrite-Free OAT Extended Life Coolant	X				X			9000/3	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A30 RM 40:60	X							9000/3	
	Hoyer Freeze A48 RM 50:50	X	X				X	X	9000/5	
YPF S.A. Argentina	Kriox MTL 50	X				X			9000/3	

Table 101:

8.9 Coolant Additives with Limited Series Approval

8.9.1 Antifreeze – Concentrates and ready mixtures based on ethylene glycol for series with and without light metal

Important
The antifreezes listed below can be used at an application concentration of 40–50% by volume. Exception: • For Series 2000 Marine, model types 00 to 07, no more than 40% by volume is admissible.

Antifreeze – Concentrates

Manufacturer	Brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AS 100 Antifreeze Concentrate	X	X						9000/3	No longer included in portfolio. Remaining stocks of this product can be used up as long as they are within their shelf life.
BASF SE	Glysantin ® G40 pink	X	X						9000/3	X00066724 (20 l) X00066725 (210 l)
	Glysantin ® G40 ECO pink BMB 100	X	X						9000/3	
Classic Schmierstoff GmbH & Co. KG	Classic Kolda UE G40 ®	X	X						9000/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F40	X	X						9000/3	
Fuchs SE	Fricofin DP	X	X						9000/3	
LAEMMLE Chemicals AG	Roxor Anti-Frost MT-650	X	X						9000/3	
Puma Energy International S.A.	Puma HD Hybrid Coolant	X	X						9000/3	
Valvoline	Zerex G40	X	X						9000/3	Material number (U.S.): 800180 (drum)
	OEM Advanced 40	X	X						9000/3	
Wilhem Hoyer B.V. & Co.KG	Hoyer Freeze A40	X	X						9000/3	

Table 102:

Antifreeze – Ready mixtures

Manufacturer	Brand name	Inhibitors							Runtime Hours/years	Comments/ material no.
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
BASF SE	Glysantin ® G40 RM/50 ECO pink BMB 100	X	X						9000/3	(50% by vol.)
Fuchs SE	Fricofin DP 50	X	X						9000/3	(50% by vol.)
Puma Energy International S.A.	Puma HD Hybrid Coolant 5050	X	X						9000/3	(50% by vol.)
SMB Sotragal Mont-Blanc	Liquide de refroidissement -37 °C FRICOTECH MBT SMB AUTO	X	X						9000/3	(50% by vol.) Antifreeze protection down to -37 °C

Table 103:

8.9.2 Antifreeze – Ready mixtures based on propylene glycol for engine series not containing light metal

Important
Propylene glycol based coolants (→ Page 203) are approved for Series 4000 model types 01 to 05 used in genset applications. Restrictions apply to the use of propylene glycol based coolants for various model types in all other Series 4000 applications. See (→ Page 157) For Series 4000C01 to C03 and 4000R01 to R03 only an application concentration of 40% is admissible. A 50/50 mixture must not be used.

Antifreeze, ready mixture

Manufacturer	Brand name	Inhibitors							Runtime Hours/Years	Comments/ Material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Fleetguard	PG XL (40%) ready mixture		X	X	X	X	X		9000 / 3	
	ES Compleat PG Premix 50/50		X	X	X	X	X		9000 / 3	

Table 104:

9 Flushing and Cleaning Specifications for Engine Coolant Circuits

9.1 General information

These cleaning instructions apply to mtu diesel and gas engines.

Assemblies installed in the engine cooling circuits are, for example, the expansion tank, preheating unit, heat exchanger, coolant cooler, oil heat exchanger, intercooler, charge-air preheater, fuel preheater, etc.

Over 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 may be the result.

Inadequate water quality or incorrect preparation can also heavily contaminate the coolant circuit.

If such malfunctions occur, the coolant circuit must be flushed out with freshwater, repeatedly if necessary.

If these flushing processes are insufficient or if the coolant circuit is too heavily contaminated, the coolant circuit and all affected assemblies must be cleaned.

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

Only products approved by Rolls-Royce Solutions or corresponding products at the specified concentrations may be used for cleaning. The specified cleaning procedure is mandatory.

Immediately after flushing or cleaning, fill the coolant circuits with treated engine coolant as stipulated in the current fluids and lubricants specifications A001061/.. (→ Page 157). 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 observed 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. Great differences can apply from country to country, and a generally valid statement on applicable regulations is therefore not possible within these flushing and cleaning specifications.
Users of the products named in these specifications are therefore obliged to inform themselves of the locally valid regulations and to follow them strictly. Rolls-Royce Solutions GmbH accepts no liability whatsoever for improper or illegal use of the fluids and lubricants/cleaning agents which it has approved.

Important

Oil heat exchangers from engines with bearing or piston seizures or friction damage must be scrapped!

Test equipment, auxiliary materials, and fluids and lubricants

Test kit (→ Table 105) or electrical pH meter
- Freshwater
- Treated engine coolant
- Superheated steam
- Compressed air

Important

Rolls-Royce Solutions recommends the test kit produced by CM Technologies GmbH (/https://www.cmtechnologies.de).

Table 105:

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9.2 Freshwater requirements for cleaning solutions and flushing water

Important
Only clean, clear water with values in accordance with those in the following table must be used for preparing cleaning solutions. If the limit values for the water are exceeded, hardness or mineral content can be decreased by adding demineralized water. The cleaning agent concentrates used for the preparation of the cleaning solution must not contain more than 100 mg/l chloride and/or 100 mg/l sulfate.

Item	Minimum	Maximum
Total earth alkalines[1)] (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
Sulphate ions		100 mg/l
Total chloride + sulfate ions		200 mg/l
Bacteria		10^3 CFU (colony forming unit)/ml
Fungi, yeasts	Not permitted!	

Table 106: Values for freshwater

[1)] = Common designations for water hardness in various countries: 1 mmol/l = 5.6°d = 100 mg/kg $CaCO_3$

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

9.3 Approved cleaning agents/disinfecting agents

Approved cleaning agents

Manufacturer	Product name	Working concentration		Order number
For coolant circuits:				
Kluthe	Hakutex 111 [1)]	2% by volume	Liquid	X00065751
	Decorrdal 20-1 [2)]	10% by volume	Liquid	X00086731
Fleetguard	Restore Plus [3)]	10% by volume	Liquid	
For coolant circuit assemblies:				
Henkel	Bonderite C-AK FD [4)]	1 to 10% by weight	Powder	[5)]
	Bonderite C-MC 11120 [6)]	2 to 10% by weight	Powder	[5)]
Kluthe	Hakutex 60 mtu [7)]	100% by volume	Liquid	X00070585 (25 kg)
	Hakupur 50-706-3 [8)]	2% by volume	Liquid	X00055629

Table 107:

Approved disinfecting agents

Manufacturer	Product name	Working concentration		Order number
For a coolant circuit contaminated with bacteria, fungi or yeast:				
Thor	Acticide MV14 [9, 10)]	0.01% by volume	Liquid	X00079756 (20 l)
	Acticide MV [10, 11)]	0.1% by volume	Liquid	X00088729 (5 l)

Table 108:

[1)] = For light lime deposits, light corrosion

[2)] = For severe corrosion, not suitable for removing corrosion from aluminum materials

[3)] = Can only be used for cleaning the Series 4000 genset coolant system contaminated by copper phosphate particles

[4)] = For lime deposits containing oil and grease

[5)] = Not stocked by Rolls-Royce Solutions.

[6)] = Preferred for heavy lime deposits

[7)] = Solvent cold cleaner for oily and greasy residues

[8)] = For oily and greasy residues. Not suitable for galvanized surfaces

[9)] = Bacteria contamination ≥ 10^5, contamination with fungi and yeast not permitted
Note application cases (→ Page 211).

[10)] =
- Storage temperature 10–30 °C
- Protect against heat and solar radiation
- Minimum shelf life 18 months
- Use personal protective equipment (PPE)

For application in the field. The smaller canister is easier to handle.
Note application cases (→ Page 211).

[11)] = For application in the field. The smaller canister is easier to handle.
Note application cases (→ Page 211).

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

The cleaning agents are available worldwide through the branches of the manufacturers or their trading partners.

9.4 Engine coolant circuits – Flushing

1. Drain engine coolant.
2. Measure the pH value of the freshwater using the test kit (→ Table 109) or electrical pH meter.

   Important

   Rolls-Royce Solutions recommends the test kit produced by CM Technologies GmbH (/https://www.cmtechnologies.de).

   Table 109:
3. Fill coolant circuit with freshwater.

   Important

   Do not pour cold water into a hot engine!
   Refer to the operating instructions of the engine for additional information
4. Preheat, start and run engine until warm.
5. Run engine for approx. 30 minutes at increased speed.
6. Stop engine.
7. Take flushing water sample at engine coolant sample extraction cock.
8. Drain flushing water.
9. Measure the pH value of the flushing water sample using the test kit (→ Table 109) or electrical pH meter and compare with the pH value of the freshwater.
10. If the pH value difference is still too large even after flushing four to five times: Clean the coolant circuit, see (→ Page 208) (→ Page 210)

9.5 Engine coolant circuits – Cleaning

1. Mix cleaner to the specified concentration with freshwater. Always 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 206).
3. In the case of powdered products, stir until the cleaning agent is completely dissolved and without sediment.
4. Pour pre-solution together with freshwater into coolant circuit.
5. Start engine and run until warm.
6. Select temperature and duration of reaction time according to the specifications in the technical data sheets of the manufacturer.
7. Stop engine.
8. Drain off cleaning agents and flush the engine coolant circuit with freshwater.
9. Take flushing water sample at engine coolant sample extraction cock.
10. Measure the pH value of the flushing water sample using the test kit (→ Table 110) or electrical pH meter and compare with the pH value of the freshwater.

Important

Rolls-Royce Solutions recommends the test kit produced by CM Technologies GmbH (/https://www.cmtechnologies.de).
Refer to the operating instructions of the engine for additional information

Table 110:

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

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

Important

The engine coolant circuit must always be vented properly to ensure complete filling. This applies when filling the engine with water, cleaning agent, corrosion inhibitor and coolant as well as in engine operation with one of the mentioned media.
In zones where air is present, neither rust removal nor preservation take place, and corrosion occurs again.
All crankcase openings, hose connection openings, etc. must be closed immediately if no longer required. There is a risk of corrosion in the area of the openings.

9.7 Cleaning engine coolant circuit assemblies

1. Remove, disassemble and clean assemblies in the engine coolant circuit 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. In case of lime deposits that contain oil and grease, degrease the water side first.
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 206)

Important

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

In order to avoid damage:
Do not use hard or sharp-edged tools (steel brushes, scrapers, etc.) (oxide protective layer).
The pressure of the water jet must not be ≤ 60 bar (to avoid damage, e.g. of the cooler fins).

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 207).
12. Check coolant system for leaks during initial operation of engine.

Important

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

9.8 Coolant circuits contaminated with bacteria, fungi or yeast

Disinfection and prevention

Microbiologically contaminated systems:

The disinfecting agent is added to the contaminated coolant.

The prerequisite for effective disinfection of the engine coolant system is that the disinfecting agent has a sufficiently long reaction time and can reach all areas of the cooling system. All external storage tanks and pipes must also be reached by the disinfecting agent.

Important

When using Acticide MV 14 (→ Page 206), the engine coolant does not need to be changed. Flushing/refilling only takes place after express recommendation by the chemical laboratory.

Dwell time:	Not less than 12 hours
Temperature:	Maximum temperature 55 °C (higher temperatures destroy the disinfecting agent)

Prevention:

If an engine is to be shut down for a long period, disinfecting agent can be added as a preventive measure. Before the engine is put back into operation, always ensure that the coolant is still in good condition. During return to operation, the coolant containing disinfecting agent can remain in the system and be reused.

The dosing (→ Page 206) and work safety specifications must be strictly observed.

Flushing

When the coolant is drained, the coolant circuit must be flushed with freshwater. The coolant circuit must be flushed as long as visible contamination can be detected, and the flushing water has the same pH value as the freshwater used (maximum deviation of pH value < 1).

Refilling

Before refilling with coolant, ensure that the cooling system is free of contamination.

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

10 Cleaning the Product Externally

10.1 General information

If, in the course of time, contaminants such as oil deposits and leaves have accumulated on the engine, it may be necessary to clean it. Clean the engine only superficially and with great care.

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

To prevent damage, observe the following before starting work and applying cleaning agents:
- Protect electrical components (battery-charging generator, plug connections, ignition cables, etc.) and the intake area from undesirable water ingress in plug connections or the combustion chamber.

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

Check all plug connections and, if necessary, blow out with compressed air after cleaning to avoid misfiring and other electrical issues.

Only products approved by Rolls-Royce Solutions at the specified concentrations can be used for cleaning. The specified cleaning procedure is mandatory.

Important

Cleaning must be carried out with pressure washers at an operating pressure of ≤ 60 bar to avoid damaging the cooler and the engine. High-pressure cleaners with an operating pressure > 60 bar are not permitted.
After washing, the equipment must be thoroughly flushed with freshwater. The specifications in chapter 9.2 "Freshwater requirements for cleaning solutions and flushing water" (→ Page 205) also apply here.
The technical data sheets and safety data sheets of the product must be observed!
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. Great differences can apply from country to country, and a generally valid statement on applicable regulations is therefore not possible within these flushing and cleaning specifications.
Users of the products named in these specifications are therefore obliged to inform themselves of the locally valid regulations. Rolls-Royce Solutions accepts no liability whatsoever for improper or illegal use of the fluids and lubricants or cleaning agents which it has approved.

Test equipment, auxiliary materials, and fluids and lubricants

Important

Rolls-Royce Solutions recommends the test kit produced by CM Technologies GmbH (/https://www.cmtechnologies.de).

Table 111:

Test kit (→ Table 111) or electrical pH meter
- Freshwater
- Superheated steam
- Compressed air

10.2 Approved cleaning agents

Manufacturer	Product name	Working concentration		Order no.
For remote cooler on air side:				
Kluthe GmbH	Hakupur 50-136 [1)]	2% by volume	Liquid	X00056700
For cleaning painted, contaminated surfaces externally:				
Kluthe GmbH	Hakupur 449 [3)]	1% by volume	Liquid	X00071179[2)]

Table 112: Approved cleaning agents

[1)] Cleaning agent for cleaning with pressure cleaner (Parameters: Pressure: ≤ 60 bar, gentle spray jet, distance from nozzle to object at least 25 cm, cleaning agent temperature: 80 °C).

[2)] Not stocked by Rolls-Royce Solutions GmbH.

[3)] The cleaner is unsuitable for components made of aluminum materials (e.g. Al coolers) and must not be used.

Important
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.

11 Revision Overview

11.1 Revision overview from version A001061/44 to A001061/45

Seq. no.	Page	Chapter	Subsection	Action	Supplement/ comments
1		Cover sheet	Cover page	Revised	
2	(→ Page 5)	Preface	General information	Revised	Complete chapter
Lubricants for four-stroke cycle engines					
3	(→ Page 7)	Lubricants for four-stroke cycle engines	Engine oils	Revised	Complete subsection
Lubricants for two-stroke cycle engines					
4	(→ Page 20)	Lubricants for two-stroke cycle engines	Engine oils	Revised	Complete subsection
Coolant					
5	(→ Page 23)	Coolant	General information	Revised	Complete subsection
6	(→ Page 36)	Coolant	Operational monitoring	Revised	Complete subsection
7	(→ Page 41)	Coolant	Coolant concentrates – Storage stability	Revised	Complete subsection
Fuels					
8	(→ Page 43)	Fuels	Diesel fuels – General information	Revised	Complete subsection
9	(→ Page 53)	Fuels	Distillate fuels according to EN 590 and ASTM D975	Revised	Complete subsection
10	(→ Page 83)	Fuels	NATO diesel fuels	Revised	Complete subsection
11	(→ Page 95)	Fuels	Paraffinic diesel fuel in accordance with EN 15940	Revised	Complete subsection
12	(→ Page 99)	Fuels	Biodiesel and biodiesel mixtures	Revised	Complete subsection
13	(→ Page 105)	Fuels	Pure vegetable oil		New data module
14	(→ Page 107)	Fuels	Diesel fuels for engines with exhaust gas aftertreatment (EGAT)	Revised	Complete chapter

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Seq. no.	Page	Chapter	Subsection	Action	Supplement/ comments
15	(→ Page 110)	Fuels	Fuel additives	Revised	Complete subsection
Approved engine oils and lubricating greases					
16	(→ Page 117)	Engine oils for four-stroke cycle engines	Series-based usability of engine oils of oil category 1	Revised	Complete subsection
17	(→ Page 120)	Engine oils for four-stroke cycle engines	Single-grade oils – Category 1, SAE grades 30 and 40 for diesel engines	Revised	Complete subsection
18	(→ Page 121)	Engine oils for four-stroke cycle engines	Multi-grade oils – Category 1, SAE grade 15W-40 for diesel engines	Revised	Complete subsection
19	(→ Page 122)	Engine oils for four-stroke cycle engines	Series-based usability of engine oils of oil categories 2 and 2.1 (low SAPS oils)	Revised	Complete subsection
20	(→ Page 126)	Engine oils for four-stroke cycle engines	Single-grade oils – Category 2, SAE grades 30 and 40 for diesel engines	Revised	Complete subsection
21	(→ Page 129)	Engine oils for four-stroke cycle engines	Multi-grade oils – Category 2, SAE grades 10W-30, 10W-40, 15W-40 and 20W-40 for diesel engines	Revised	Complete subsection
22	(→ Page 137)	Engine oils for four-stroke cycle engines	Multi-grade oils – Category 2.1 (low SAPS oils), SAE grades 0W-30, 10W-30, 5W-40, 10W-40 and 15W-40 for diesel engines	Revised	Complete subsection

Seq. no.	Page	Chapter	Subsection	Action	Supplement/ comments
23	(→ Page 143)	Engine oils for four-stroke cycle engines	Series-based usability of engine oils of oil categories 3 and 3.1 (low SAPS oils)	Revised	Complete subsection
24	(→ Page 146)	Engine oils for four-stroke cycle engines	Multi-grade oils – Category 3, SAE grades 5W-30, 5W-40, 10W-40 and 15W-40 for diesel engines	Revised	Complete subsection
25	(→ Page 149)	Engine oils for four-stroke cycle engines	Multi-grade oils – Category 3.1 of SAE grades 5W-30, 10W-30 and 10W-40 for diesel engines	Revised	Complete subsection
Approved coolants					
26	(→ Page 157)	Series- and application-based usability of coolant additives		Revised	Complete chapter
27	(→ Page 166)	Coolant without antifreeze for cooling systems containing light metal	Coolant without antifreeze – Concentrates	Revised	Complete subsection
28	(→ Page 168)	Coolant without antifreeze for cooling systems containing light metal	Coolant without antifreeze – Ready mixtures	Revised	Complete subsection
29	(→ Page 169)	Coolant without antifreeze for cooling systems free of light metal	Coolant without antifreeze – Concentrates	Revised	Complete subsection
30	(→ Page 171)	Coolant without antifreeze for cooling systems free of light metal	Coolant without antifreeze – Ready mixtures	Revised	Complete subsection
31	(→ Page 172)	Antifreeze for cooling systems containing light metal	Antifreeze – Concentrates	Revised	Complete subsection
32	(→ Page 175)	Antifreeze for cooling systems containing light metal	Antifreeze – Ready mixtures	Revised	Complete subsection

Seq. no.	Page	Chapter	Subsection	Action	Supplement/ comments
33	(→ Page 178)	Antifreeze for cooling systems free of light metal	Antifreeze – Concentrates	Revised	Complete subsection
34	(→ Page 181)	Antifreeze for cooling systems free of light metal	Antifreeze – Ready mixtures	Revised	Complete subsection
35	(→ Page 185)	Coolant additives for Series 60 engines	Coolant without antifreeze – Concentrates for Series 60 engines	Revised	Complete subsection
36	(→ Page 187)	Coolant additives for Series 60 engines	Antifreeze – Concentrates for Series 60 engines	Revised	Complete subsection
37	(→ Page 190)	Coolant additives for Series 60 engines	Antifreeze – Ready mixtures for Series 60 engines	Revised	Complete subsection
38	(→ Page 193)	Coolant additives for two-stroke cycle engines	Coolant without antifreeze – Concentrates for two-stroke cycle engines	Revised	Complete subsection
39	(→ Page 194)	Coolant additives for two-stroke cycle engines	Coolant without antifreeze – Ready mixtures for two-stroke cycle engines	Revised	Complete subsection
40	(→ Page 195)	Coolant additives for two-stroke cycle engines	Antifreeze – Concentrates for two-stroke cycle engines	Revised	Complete subsection
41	(→ Page 198)	Coolant additives for two-stroke cycle engines	Antifreeze – Ready mixtures for two-stroke cycle engines	Revised	Complete subsection
42	(→ Page 201)	Coolant additives with limited series release	Antifreeze – Concentrates and ready mixtures based on ethylene glycol for series with and without light metal	Revised	Complete subsection
Flushing and cleaning specifications for engine coolant circuits					
43	(→ Page 204)	General information		Revised	Complete chapter

Seq. no.	Page	Chapter	Subsection	Action	Supplement/ comments
44	(→ Page 206)	Approved cleaning agents/ disinfecting agents		Revised	Complete chapter
45	(→ Page 207)	Engine coolant circuits – Flushing		Revised	Complete chapter
46	(→ Page 208)	Engine coolant circuits – Cleaning		Revised	Complete chapter
47	(→ Page 211)	Coolant circuits contaminated with bacteria, fungi or yeast		Revised	Complete chapter
Cleaning the product from the outside					
48	(→ Page 212)	General information			Complete chapter
Revision overview					
49	(→ Page 214)	Revision overview	Revision overview from version A001061/43 to A001061/44	Revised	Complete chapter

Table 113:

12 Appendix A

12.1 Index