



Fluids and Lubricants Specifications

Fluids and Lubricants Specifications for Series 1800 PowerPack

A001062/06E

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1 Preface

1.1 General

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 that have to be observed, work that has to be performed and activities that have to be carried out to prevent damage to or destruction of the material.

Note:

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

Fluids and lubricants

The service life, operational reliability and function of the drive units are largely dependent on the fluids and lubricants used. The correct selection and treatment of these fluids and lubricants is therefore extremely important. They are defined in these Fluids and Lubricants Specifications.

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

Table 1: Test standards for fluids and lubricants

Monitoring fluids and lubricants

The maintenance of fluids and lubricants includes regular monitoring. Relevant information on how samples must be taken and handled 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>

Changing fluids and lubricants

If not specified otherwise in the project-specific Operating Instructions, the change intervals defined in these Fluids and Lubricants Specifications are valid for all fluids and lubricants.

Applicability of this publication

The Fluids and Lubricants Specifications will be amended or supplemented as necessary. Prior to operation, make sure that you have the latest version available. The latest version can also be found at:

<http://www.mtu-solutions.com> (applies to Series 1800 PowerPack only).

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

The Fluids and Lubricants Specifications apply to PowerPacks with Series 6H 1800 engines which comply with the emission levels

- Euro 3
- EU Stage IIIA/EPA Tier 3 (with diesel particulate filter but without SCR exhaust gas aftertreatment)
- EU Stage IIIB/EPA Tier 4i
- EU Stage V

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

These regulations are contained in the manufacturers' instructions, legal requirements and technical guidelines valid in the individual countries. Great differences may 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 must therefore undertake 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 which it has approved.

Preservation

All information on preservation, reprereservation and depreservation, including the approved preservatives, is available in the Preservation and Reprereservation Specifications (publication number A001070/...). The latest version can also be found at:

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

2 Engine Oils

2.1 General

Engine oils

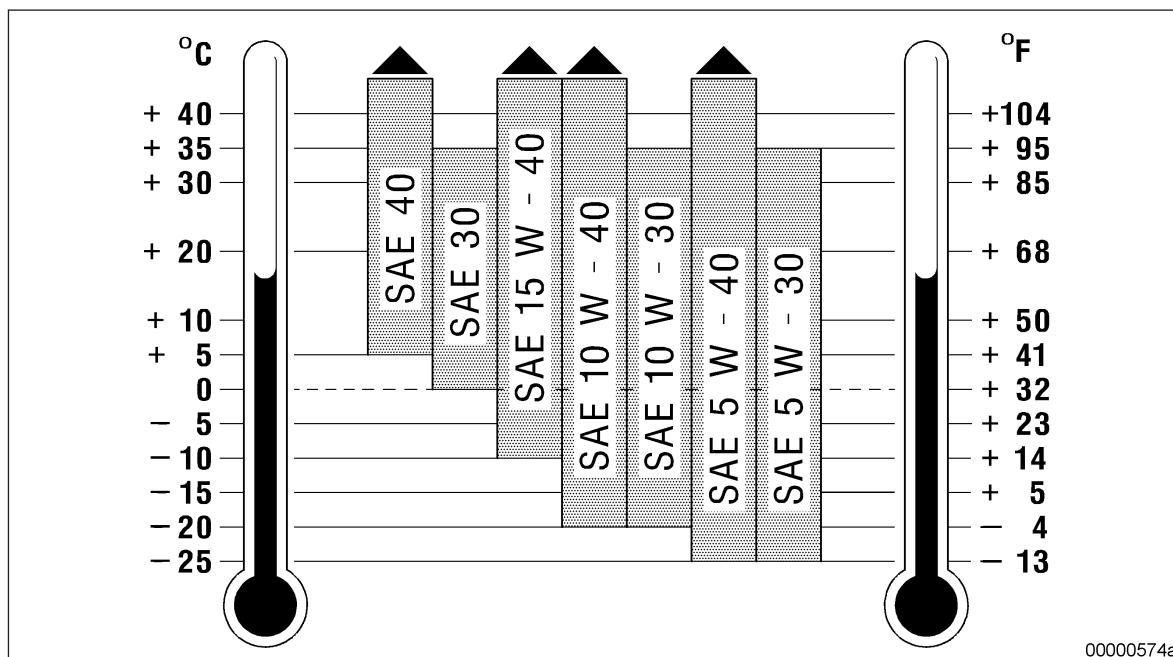
Important

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

Selecting 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 Chart 1.

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



00000574a

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

Engine oils for Series 6H 1800 engines

Important

For engine model 6H 1800, only engine oils in accordance with chapter 2.2 (→ Page 8) can be used.

For engines equipped with a diesel particulate filter, only "Low SAPS oils" in accordance with chapter 2.2 (→ Page 8) can be used.

The oil change interval is 1,000 operating hours or max. 1 year under the condition that approved fuels as per Chapter 7 (→ Page 45) are used.

Prior to using non-approved fuels, contact Rolls-Royce Solutions to determine the applicable oil change intervals

Operating the engines with biodiesel/FAME according to DIN EN 14214¹⁾ curtails the oil change intervals, see chapter 7 (→ Page 45).

¹⁾ = Latest edition

Mixing engine oils

For this, see the table entitled 'Important' (→ Page 8).

2.2 Approved multi-grade oils according to DTFR specifications

Approved engine oils

The approved engine oils can be found in the fluids and lubricants lists of Daimler Truck AG at:

- Multi-grade oils according to specification DTFR 15B120 <https://bevo.mercedes-benz-trucks.com> for Euro 3 and EU Stage IIIA engines without DPF
- Low SAPS multi-grade oils according to specification DTFR 15C110 <https://bevo.mercedes-benz-trucks.com> for Euro 3, EU Stage IIIB if DPF is retrofitted by the customer.
- Low SAPS multi-grade oils according to specification DTFR 15C110 or 15C120 <https://bevo.mercedes-benz-trucks.com> for EU Stage V with DPF.

Important

Mixing engine oils with different specifications and/or viscosity grades 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.

Emission level	DPF	DTFR 15B120	DTFR 15C110 Low ash	DTFR 15C120 Low ash
Euro 3 EU Stage IIIA with- out DPF	Without	Approved	Approved	-
Euro 3 EU Stage IIIA EU Stage IIIB	If retrofitted by the customer	-	Approved	-
EU Stage V	With	-	Approved	Approved

Table 2:

Note

Initial filling for EU Stage IIIA, EU Stage IIIB and EU Stage V follows Installation Supplement WT00056257 which accompanies the PowerPack.
Engine oils with the same specification (e.g. DTFR 15110) and viscosity (e.g. 5W30) can be mixed, the brand is irrelevant. To monitor the oil and/or track wear using oil samples, a "pure" oil grade originating from the same oil manufacturer is required/advisable.

3 Generator Lubricants

3.1 Lubricating greases

Lubricating greases for TSA traction generators

Extract from TSA operating and assembly instructions documentation

TSA documentation is updated from time to time. Prior to operation, make sure that you have the latest version available. Please contact your Rolls-Royce Solutions representative to clarify.

Important

Mixtures of different lubricating greases are not permitted!

Lubricating grease change intervals based on operating hours/years

Operating hours	Years
2000	One (12 months)

Table 3: Lubricating grease change intervals based on operating hours/years

Lubricating greases for TSA traction generators

TSA documentation is updated from time to time. Prior to operation, make sure that you have the latest version available. Please contact your Rolls-Royce Solutions representative to clarify.

Important

Use TSA-approved grease only. The use of other types of grease, grease blends or contaminated lubricating greases is prohibited!
Operating the generator with any grease which has not been approved by TSA will void the warranty for the generator!

Manufacturer	Brand name	Comments
Schaeffler AG	Arcanol Temp90	

Table 4: Lubricating greases for TSA traction generators

4 Transmission Oils

4.1 Transmission oils for ZF transmissions

Lubricant classes for ZF transmissions

(Excerpt from the ZF List of Lubricants TE-ML 16, Edition 2025-01-14)

The ZF Lists of Lubricants are updated every three months on January 1, April 1, July 1 and October 1. Prior to operation, make sure that you have the latest version available. The latest version can also be found at:

Lubricant list TE-ML 16: <https://aftermarket.zf.com/de/aftermarket-portal/unser-katalog/schmierstoffe/> An excerpt from this list is shown in the following table.

Product groups automatic transmissions for rail vehicles	Lubricant classes for service filling ⁽¹⁾ Transmission without/with ZF Intarder
ASRail • 12 AS 2303, 12 AS 2703, 12 AS 3103, 16 AS 2603	16K/16P
Ecomat • HP 500 R, HP 590 R, HP 600 R • HP 502 R, HP 592 R, HP 602 R	16M/16N Automatic Transmission Fluid (ATF) ⁽²⁾
Ecomat • HP902 R	16N
EcoLife • 6AP2000R, 6AP2500R	16N/16Q/16S
EcoLife 2 • 6AP2520R	16N/16Q
EcoWorld • 6AP2004RI, 6AP2504RI	16N/16Q
EcoWorld 2 • 6AP2024RI, 6AP2524RI	16N/16Q

Table 5: Excerpt from the ZF List of Lubricants TE-ML 16, Edition 2025-01-14

⁽¹⁾ = Approved commercial products, oil change intervals and low temperature limits (listed in the following table).

⁽²⁾ = Particularly recommended: The fully synthetic ATF ZF-Ecofluid A Life was developed specifically for use in Ecomat transmissions. This combination of a synthetic base oil with a specially balanced additive package delivers excellent oxidation stability, highly consistent friction characteristics and high-quality protection for all transmission components. With its flat viscosity curve, this oil is particularly well-suited to operation in cold as well as in hot climatic zones.

Follow the instructions for greasing points in the manual.

Important

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

T1M-ID: 000017/66 - 003

Oil change intervals for ASRail transmissions:

Lubricant classes ⁽¹⁾	Oil change interval [km/years] ^(2,3)
16K	300,000 km/every two years
16P	360,000 km/every three years

Table 6:

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

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

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

Oil and filter change intervals for Ecomat transmissions HP 500 R, HP 590 R, HP 600 R, HP 502 R, HP 592 R and HP 602 R for rail vehicles:

Lubricant classes ⁽¹⁾	Oil and filter change interval [km/years] ^(2,3)
16M	120,000 km/every two years
16N	150,000 km/every three years

Table 7:

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

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

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

Oil and filter change intervals for Ecomat transmissions HP 902 R for rail vehicles:

Lubricant classes ⁽¹⁾	Oil and filter change interval [km/years] ^(2,3)
16N	120,000 km/every three years

Table 8:

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

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

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

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

Lubricant classes ⁽¹⁾	Oil and filter change interval [km/years] ^(2,3)
16S	120,000 km/every two years
16N/16Q	180,000 km/every three years

Table 9:

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

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

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

Oil and pressure filters – Change intervals for EcoWorld transmissions for rail vehicles:

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

Table 10:

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

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

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

Application areas of lubricants

The following illustration shows application areas of the various SAE classes in relation to the ambient temperatures to be expected.

The oils have a bottom limit of a maximum dynamic viscosity (Brookfield) of 150,000 mPas. This corresponds approximately to the limit of flowability at low temperatures.

The upper limit is determined by the load in the transmission and the temperature experienced during operation. It can be assumed that high ambient temperatures will also result in higher oil sump temperatures. For more detailed information on the low temperature limit of the respective product, see the safety data sheet of the oil manufacturer.

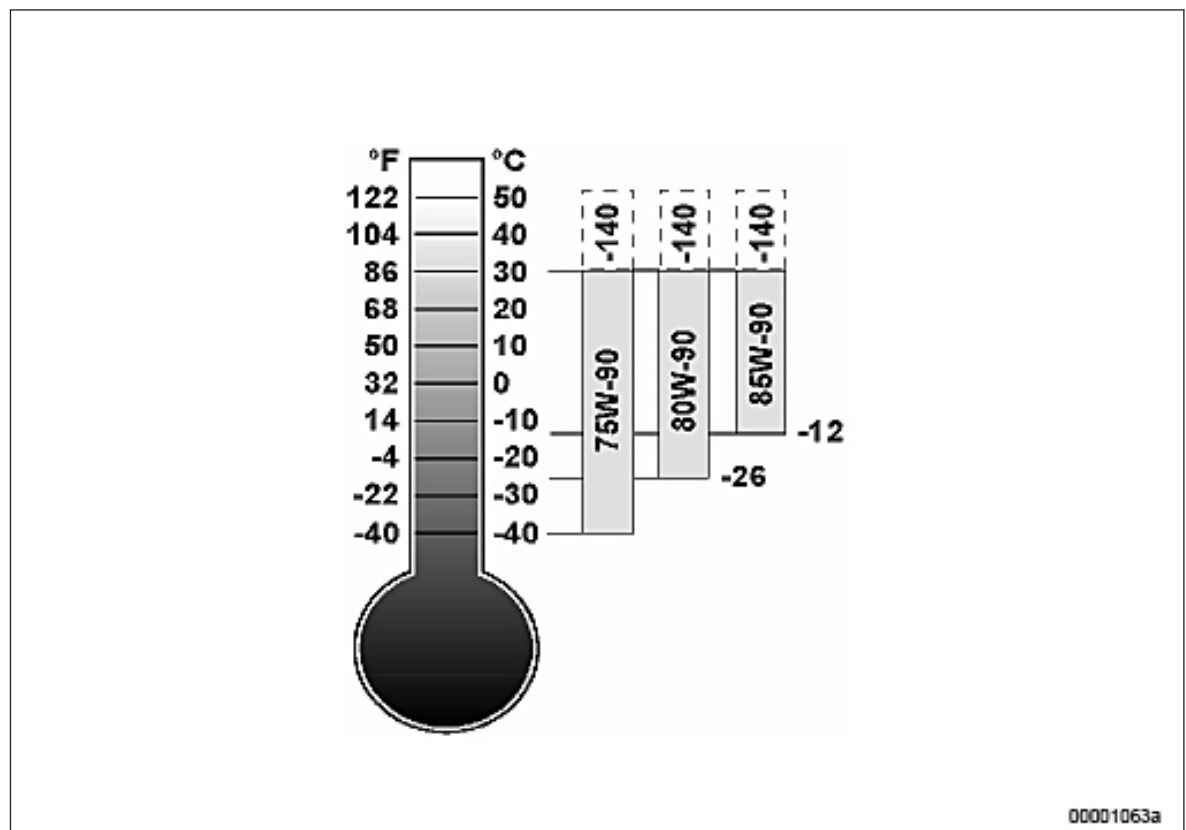


Figure 2: Range of use for transmission oil

The user must observe the low temperature limits!

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

Table 11:

Fluids and lubricants for ZF transmissions

Details of currently approved fluids and lubricants for ZF transmissions can be downloaded free of charge from the following Internet address:

Lubricant list TE-ML 16 <https://aftermarket.zf.com/de/aftermarket-portal/unser-katalog/schmierstoffe/>

Before use, make sure you have the latest version and compare it with the excerpts from the list shown here.

Lubricant class 16K – Transmission oil of viscosity class: SAE 75W-80 (base oil partly synthetic, synthetic, suitable for interarders)

Manufacturer	Product name
Addinol Lube Oil GmbH, Leuna/DE	Addinol Getriebeöl GS 75W-80 SL
BayWa AG München, München/DE	Tectrol Syntogear MA 7580
Belgin Madeni Yaglar Tic. VE San. A.S., Ko-caeli/TR	Belgin Lubex Mitras MT EP SYN 75W-80
Castrol LTD, London/GB	Transmax Manual Z 75W-80
Cepsa Comercial Petróleo S.A.U., Madrid/ES	Cepsa Transmisiones FE+LD 75W-80
Champion Chemicals N.V., Hemiksem/BE	Champion OEM Specific 75W80 ZF
Chevron Lubricants, San Ramon, CA/US	Delo SYN-MTF XZ 75W-80
De Oliebron BV, Zwijndrecht/NL	Tor MT/LD Gear Oil 75W80
Deutsche Ölwerke Lubmin, Lubmin/DE	Aveno Truck Gear Longlife 75W-80
Dongfeng Commercial Vehicle CO. LTD, Hu-bei/CN	DFCV-HDT 31
ENI S.P.A., Rome/IT	ENI Rotra Multigear 75W-80
Europart Trading GmbH, Hagen/DE	Europart Synthogear Int. 75W80
ExxonMobil Corporation, Houston, TX/US	Mobil Delvac 1 Transmission Fluid 75W-80
Finke Mineralölwerk GmbH, 27374 Visselhö-vede/DE	AVIATICON Finkogear MTF 75W-80
Fuchs Petrolub SE, Mannheim/DE	Fuchs Titan Cytrac MAN SYNTH SAE 75W-80
Fuchs Petrolub SE, Mannheim/DE	Fuchs Titan Cytrac MAT SAE 75W-80
Gulf Oil International, Mumbai/IN	Gulf Syngear FE 75W-80
Gulf Western Oil (Aust) PTY LTD, St. Marys/AU	Ultra Shift M Synthetic Manual Transmission Fluid
Igol France, Amiens/FR	Igol Transgear ZF Plus 75W-80
INA Maziva LTD., Zagreb/HR	INA Transmol HD SAE 75W-80
Kuwait Petroleum International Lubricant, Ant-werp/NL	Q8 Gear Oil V 75W-80
Kuwait Petroleum International Lubricant, Ant-werp/NL	Q8 T 60 Ntech 75W-80
Liqui Moly GmbH, Ulm/DE	Liqui Moly Truck Getriebeöl HC GL4 SAE 75W-80
Lukoil Lubricants Europe GMBH, Vienna/AT	Lukoil Transmission SYNTH MPV 75W-80
Meguin GmbH & Co. KG, Saarlouis/DE	Megol Premium Getriebeöl HC GL 4 75W80

Manufacturer	Product name
MOL-LUB Kft. Almasfuzito/HU	Mol Hykomol Syntrans 75W80
Motorex AG, Langenthal/CH	Motorex York Prisma TF SAE 75W-80
Motorex AG, Langenthal/CH	York 994
Oy Teboil AB, Helsinki/FI	Teboil Gear MTF-V
Pakelo Motor Oil, San Bonifacio (VR)/IT	Goldengear LD Plus SAE 75W-80
PAZ Lubricants & Chemicals, Haifa/IL	PAZ Trans Ultra 75W-80
Petro-Canada Lubricants INC., Mississauga, Ontario/CA	Traxon Synthetic MTF 75W-80
Petrochina Lubricant Company, Beijing/CN	Kunlun ZFGO 02L
Petrogal S.A., Lisboa/PT	Galp Transvex TDL Ultra 75W80
Petrol Ofisi A.S., Istanbul/TR	Maxigear S 75W-80
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Petronas Tutela MTF 700 HD 75W-80
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Tutela Transmission FE-Gear (SAE 75W-80)
PHI Oil GMBH, St. Georgen/AT	Gear Oil MDV Silver 75W80
Raloy Lubricantes, S.A. DE C.V., Santiago Tianguisten/MX	Krönen Transmission Synthetic Oil 341 SAE 75W80
Ravensberger Schmierstoffvertrieb GmbH, Werther/DE	Ravenol SSG Spec Synt LKW Getriebeöl 75W-80
Repsol Lubricantes y Especialidades, S.A, Madrid/ES	Repsol Navigator FE LL 75W80
Rolf Lubricants GmbH, Leverkusen/DE	Rolf Transmission S7 GE 75W-80
Shell International Petroleum Comp. LTD, London/GB	Shell Spirax S6 GXME 75W- 80
Sinopec Lubricant CO., LTD., Beijing/CN	Sinopec Greatwall MTF 02L 75W-80
SK Enmove CO, Seoul/KR	SK Gear EP 75W-80 ZF
SK Enmove CO, Seoul/KR	ZIC ZS G-EP HP 75W-80
Tamoil Italia SPA, Milano/IT	Tamoil Tamgear Plus SAE 75W-80
Tongyi Petroleum Chemical CO., LTD., Beijing/CN	Tongyi Gear Oil MTF 75W-80
Totalenergies Lubrifiants, Nanterre/FR	Traxium Gear 8 FE 75W-80
Totalenergies Lubrifiants, Nanterre/FR	Tranself LD 75W80
Unil Opal, Saumur/FR	Gerion LD 75W80
Valvoline Europe, Dordrecht/NL	Valvoline Heavy Duty Gear Oil PRO 75W-80 LD
Valvoline Europe, Dordrecht/NL	NESTE Pro Gear 75W-80
Vibra Energia S.A., Duque de Caxias/BR	Lubrax Gold XP SAE 75W-80
Wilhelm Hoyer B.V. & Co. KG, Visselhövede/DE	Hoyer Gear F-TF 75W-80
Wolf Oil Corporation N.V., Hemiksem/BE	Wolf Officialtech 75W80 ZF
Yacco SAS, St. Pierre Les Elbeuf/FR	BVX Z 1000 75W-80
Zeller+Gmelin GmbH&CO.KG , Eislingen/DE	Divinol Synthogear Int. 75W80
ZF Friedrichshafen AG, Friedrichshafen/DE	ZF Ecofluid M1

Table 12:

Lubricant class 16M (ATF)

Manufacturer	Product name
Addinol Lube Oil GMBH, Leuna/DE	Addinol ATF XN HD
Allegheny Petroleum, Wilmerding, PA/US	Altra SHL Extended Drain ZF 20C
BASF SE, Ludwigshafen/DE	Emgard 2805
Belgin Madeni Yaglar TIC. VE SAN. A.S., Ko-caeli/TR	Belgin Lubex Mitras ATF SYN Ultra
Castrol LTD, London/GB	Castrol Transmax ATF Z
Castrol LTD, London/GB	Castrol Transynd
Castrol LTD, London/GB	TES-295 SYN Transmission Fluid
Cepsa Comercial Petróleo S.A.U., Madrid/ES	Cepsa ATF 4000 S
Champion Chemicals N.V., Hemiksem/BE	Champion OEM Specific Multi Vehicle ATF HD-LD
Exol Lubricants LTD, Wednesbury/GB	Autotrans ELC
ExxonMobil Corporation Houston, TX/US	Mobil Delvac 1 ATF
Fuchs Petrolub SE, Mannheim/DE	Transway ATF ULTRA
Fuchs Petrolub SE, Mannheim/DE	Fuchs Titan ATF 5500
Gulf Western Oil (AUST) PTY LTD, St. Marys/AU	SYN-TS® ZFV
H. Bantleon GmbH / Gesells. d. Avia, Ulm/DE	Avilub Fluid ATZ 295
Hi-Tec Oils, Smithfield/AU	Multitrans Plus ATF
John Deere, Moline, Illinois/US	HD Synthetic Transmission Fluid
Lukoil Lubricants Europe GMBH, Vienna/AT	Lukoil ATF Synth MN Z3
Motorex AG, Langenthal/CH	York 886
Motorex AG, Langenthal/CH	Motorex_York ATF VZ
Motul SA, Aubervilliers/FR	Motul ATF HD
Opet Fuchs Madeni Yag. San. ve TIC. A.S., IZ-MIR/TR	Otokar Spectra ATF Z
Oy Teboil AB, Helsinki/FI	Teboil Fluid ES-MAX
Pakelo Motor Oil S.P.A. A.S.U., San Bonifacio (VR)/IT	ATF XT III Fluid Plus
Petro-Canada Lubricants Inc., Mississauga, Ontario/CA	Duradrive HD Long Drain ATF
Petrogal S.A., Lisboa/PT	Galp Transmatic Z
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Tutela ATF 900 HD
Repsol Lubricantes y Especialidades, S.A, Madrid/ES	Repsol Matic Sintetico
Repsol Lubricantes y Especialidades, S.A, Madrid/ES	Repsol Automator ATF 14C
S.I.RA.L., Nola Napoli/IT	Siroil ATF Maximum
Sasol Energy, Johannesburg/ZA	SYN Transmission Oil VI
Singapore Petroleum Company Limited, Singapore/SG	Durashift ATF HDLD
Sinopec Lubricant CO., LTD., Beijing/CN	Sinopec Greatwall Fully Synthetic ATF HD S
Sinopec Lubricant CO., LTD., Beijing/CN	Sinopec Greatwall Synthetic ATF HD
Tedex S.A., Warszawa/PL	Tedex ATF Synthetic (S)

Manufacturer	Product name
Tongyi Petroleum Chemical CO., Ltd., BEI-JING/CN	Lingxian 10+ Automatic Transmission Fluid
Wolf Oil Corporation N.V., Hemiksem/BE	Wolf Officialtech Multi Vehicle ATF HD-LD

Table 13:

Lubricant class 16N (ATF)

Manufacturer	Product name
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Tutela Transmission ATF 120
Shell International Petroleum Comp. LTD., London/GB	Shell Spirax S6 ATF ZM
ZF Friedrichshafen AG, Friedrichshafen/DE	ZF-Ecofluid A Life

Table 14:

Lubricant class 16P – Transmission oil of viscosity class: SAE 75W-80

Manufacturer	Product name
Castrol LTD, London/GB	Castrol Transmax Manual Z Long Life 75W-80
Cepsa Comercial Petróleo S.A.U., Madrid/ES	Cepsa Transmisiones Z5 FE+LD 75W80
Fuchs Petrolub SE, Mannheim/DE	Fuchs Titan Cytrac Ultra Synth SAE 75W-80
Huiles Berliet S.A., Saint-Priest/FR	RTO Longevia BZV ECO 75W-80
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Tutela Transmission XT-D 540 (SAE 75W-80)
Totalenergies Lubrifiants, Nanterre/FR	Traxium Gear 9 FE 75W-80
ZF Friedrichshafen AG, Friedrichshafen/DE	ZF Ecofluid M SAE 75W-80

Table 15:

Lubricant class 16Q

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

Table 16:

Lubricant class 16S

Manufacturer	Product name
Addinol Lube Oil GMBH, Leuna/DE	Addinol ATF XN HD
Allegheny Petroleum, Wilmerding, PA/US	Altra SHL Extended Drain ZF 20C
BASF SE, Ludwigshafen/DE	Emgard 2805
Belgin Madeni Yaglar TIC. VE SAN A.S., Kocaeli/TR	Belgin Lubex Mitras ATF SYN Ultra
Bellini S.P.A., Zanica/IT	ATF Oil PAO Premium Extra SAE 75W
Castrol LTD, London/GB	Castrol Transmax ATF Z
Castrol LTD, London/GB	Castrol Transynd
Castrol LTD, London/GB	TES-295 SYN Transmission Fluid
Cepsa Commercial Petróleo S.A.U., Madrid/ES	Cepsa ATF 4000 S
Champion Chemicals N.V. Hemiksem/BE	Champion OEM Specific Multi Vehicle ATF HD-LD

Manufacturer	Product name
Exol Lubricants LTD, Wednesbury/GB	Autotrans ELC
ExxonMobil Corporation Houston, TX/US	Mobil Delvac 1 ATF
Fuchs Petrolub SE, Mannheim/DE	Transway ATF ULTRA
Fuchs Petrolub SE, Mannheim/DE	Fuchs Titan ATF 5500
Gulf Western Oil (AUST) PTY LTD, St. Marys/AU	SYN-TS® ZFV
H. Bantleon GmbH / Gesells. d. Avia, Ulm/DE	Avilub Fluid ATZ 295
Hi-Tec Oils, Smithfield/AU	Multitrans Plus ATF
John Deere, Moline, Illinois/US	HD Synthetic Transmission Fluid
Kuwait Petroleum International Lubricant, Antwerp/NL	Q8 Auto 15 S
Liqui Moly GmbH, Ulm/DE	Liqui Moly Top Tec ATF 1700
Lukoil Lubricants Europe GMBH, Vienna/AT	Lukoil ATF Synth MN Z3
MOL-LUB Kft. Almasfuzito/HU	MOL ATF 295
Motorex AG, Langenthal/CH	York 886
Motorex AG, Langenthal/CH	Motorex_York ATF VZ
Motul SA, Aubervilliers/FR	Motul ATF HD
Opet Fuchs Madeni Yag. San. ve TIC. A.S., IZ-MIR/TR	Otokar Spectra ATF Z
Oy Teboil AB, Helsinki/FI	Teboil Fluid ES-MAX
Pakelo Motor Oil, San Bonifacio (VR)/IT	ATF XT III Fluid Plus
Petro-Canada Lubricants Inc., Mississauga, Ontario/CA	Duradrive HD Long Drain ATF
Petrogal S.A., Lisboa/PT	Galp Transmatic Z
Petronas Lubricants International SDN BH, Kuala Lumpur/MY	Petronas Tutela ATF 900 HD
Repsol Lubricantes y Especialidades, S.A, Madrid/ES	Repsol Matic Sintetico
Repsol Lubricantes y Especialidades, S.A, Madrid/ES	Repsol Automator ATF 14C
S.I.RA.L., Nola Napoli/IT	Siroil ATF Maximum
Sasol Energy, Johannesburg/ZA	SYN Transmission Oil VI
Singapore Petroleum Company Limited, Singapore/SG	Durashift ATF HDLD
Sinopec Lubricant CO., LTD., Beijing/CN	Sinopec Greatwall Fully Synthetic ATF HD S
Sinopec Lubricant CO., LTD., Beijing/CN	Sinopec Ggreatwall Synthetic ATF HD
Tamoil Italia SPA, Milano/IT	Tamoil ATF Long Life HD
Tedex S.A., Warszawa/PL	Tedex ATF Synthetic (S)
Tongyi Petroleum Chemical CO., Ltd., BEIJING/CN	Lingxian 10+ Automatic Transmission Fluid
Wolf Oil Corporation N.V., Hemiksem/NL	Wolf Officialtech Multi Vehicle ATF HD-LD

Table 17:

4.2 Transmission oils for Voith transmissions

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

Voith hydrodynamic transmissions:

Make sure the fluids and lubricants listed below are still approved before use. The latest specifications are available at: www.voith.com

Important

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

Operating the generator with any oil which has not been approved by Voith may void the warranty for the turbo transmission.

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

Manufacturer	Product category	Index	Suitable for low temperatures ^{*)} down to
Addinol	SGL 18	1	-25 °C
ARAL	ARAL Degol BG 32		-20 °C
Caltex	Torque Fluid 32	2	-25 °C
Castrol	Castrol Alpha VT 32	1	-25 °C
	Castrol Hyspin HL-XP 32	2	-25 °C
Chevron Texaco	Textran V 32	2	-25 °C
ExxonMobil	Mobilfluid 125	2	-20 °C
Finke	Aviaticon ML 32 SG	1	-25 °C
Fuchs-Europe	Renofluid TF 1500	1	-25 °C
Hoyer	Hoyer Hydtrans ML 32 SG	1	-25 °C
INA Maziva	INA Fluid V 32	2	-25 °C
	INA Fluid VT 32	1	-25 °C
Q8	Q8 Auto R 26	2	-25 °C
Shell	Shell Tegula V 32	1	-25 °C
SRS	SRS Wiolan HF 32 DB	1	-25 °C
	SRS Wiolan HF 32 synth	3	-40 °C
Total	Total Azolla VTR 32		-20 °C
Voith Turbo s.r.l.	Turbo Transmission Fluid	1	-25 °C
	Turbo Transmission Fluid Synth	3	-40 °C

Table 18: Excerpt from the list

Explanation of the Index column:

1 = Increased thermal-oxidation resistance.

2 = Oil is not suitable for all electronically controlled turbo transmissions except for T 211 ...

3 = Especially increased thermal-oxidation resistance (synthetic oil)

^{*)} = Minimum admissible oil sump temperature. Other requirements for operation of the turbo transmission are specified in the Operating Instructions.

Fluids and lubricants for Voith transmission unit DIWA 884.5/SWG

Voith transmission unit DIWA 884.5/SWG:

Make sure the fluids and lubricants listed below are still approved before use. Prior to operation, make sure that you have the latest version (list of DIWA approved oils) available. The latest version can also be found at:

www.voith.com

Important

This list of approved oils does not apply to North America, see VTI-DIWA Service Bulletin 013 and 118
This list of approved oils does not apply to Latin America, see DIWA Service Bulletin LAT013

Approved fluids and lubricants for Voith transmission unit DIWA 884.5/SWG

Manufacturer	Product name
Voith Turbo s.r.l.	V Liquid BLU S
Addinol Lube Oil GmbH	Addinol ATF XN 5
BP Lubricants USA Inc.	BP Autran Syn 295
Castrol Ltd.	Castrol TranSynd
Cepsa Comercial Petróleo S.A.	CEPSA ATF 3000 S
Chevron	Delo Syn ATF HD
Daqing LETOF Lubricating Oil Co., Ltd.	VH556
Delek Industries Ltd.	Delek ATF LD V D-III
Ellis Enterprises East d.o.o. Kruševac	Motoil D IIIH
Exol	Autotrans ELC
ExxonMobil Corp.	Mobil Delvac 1 ATF
	Mobil ATF LT 71141
Fuchs Petrolub SE	Titan ATF 5005
Gulf Oil International	Gulf Multi-Vehicle ATF
ICONIC Lubrificantes S.A.	Ipiranga ATF OEM Premium
INA Maziva Ltd.	INA ATF DX IIIH
Kuwait Petroleum	Q8 Auto 15 S
Liqui Moly GmbH	Liqui Moly Top Tec ATF 1700
Meguin GmbH & Co. KG, Mineralölwerke	megol Getriebeöl ATF Synergistic
Mol-Lub	Mol ATF Synt 3H
	Mol ATF 295
Motorex AG	Motorex ATF TP
NIS AD Novi Sad	Nisotec ATF III Sint
OOO "LLK-International"	Lukoil ATF Synth MN Z3
	Lukoil ATF Synth Multi
Pakelo Motor Oil S.r.l.	Pakelo ATF XT III Fluid plus
	Pakelo Auxon II E
	Pakelo Auxon III Plus
Panolin AG	Panolin ATF Super VTX
PAZ Lubricants & Chemicals	PAZ Power ATF
Petrobras Distribuidora S.A.	Lubrax ATF HD
Phi Oil GmbH	ATF D3 Gold
RN-Lubricants LLC	Rosneft Kinetic ATF III Synt

Manufacturer	Product name
Sinopec Lubricant C., LTD.	Sinopec Greatwall Fully Synthetic ATF HD S
	Sinopec Greatwall ATF HD S
SRS Schmierstoff Vertrieb GmbH	SRS Violin ATF III MV
Tamoil Italia S.p.A.	ATF Long Life HD
TEDEX S.A.	TEDEX ATF Synthetic (S)
Tong Yi Petroleum Chemical Co., Ltd.	LingXian 10+ Automatic transmission Fluid

Table 19: Excerpt from the list

4.3 Fluids and lubricants for Rolls-Royce Solutions intermediate gears (Hybrid-PowerPack®)

Important

Mixing transmission oils with different specifications and/or viscosity grades is strictly prohibited!
Topping up engine oil with a different approved oil brand than currently used in the engine is also strictly prohibited!

First oil change after 500 h, then every 2000 h

Approved fluids and lubricants for Rolls-Royce Solutions intermediate gears

Manufacturer	Product name
Aral AG	Aral Getriebeöl ATF LD
Castrol Ltd.	Castrol Transmax ATF Z

Table 20:

5 Hydraulic Oils

5.1 General information

General information

Note

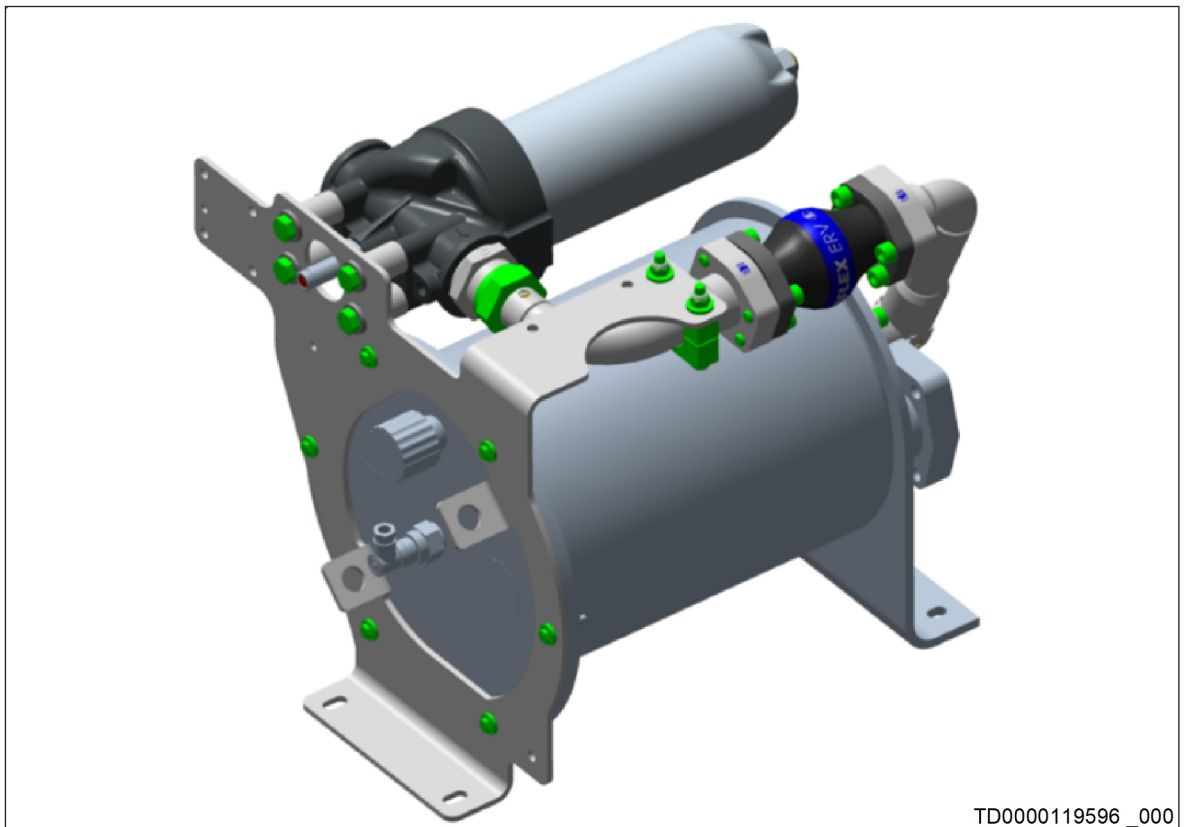
The oil from the barrel must be filtered when changing oil in hydraulic systems. **Recommendation** -> Use 1000 l containers instead of oil drums to reduce dirt ingress. When refilling as part of an oil change, when refilling with Panolin hydraulic oil or engine oil as hydraulic oil, this should be filtered at 3 μ , but as a minimum at 7 μ . A corresponding filter must be connected upstream of the filling system.

The following chapters provide details.

- Chapter on the hydraulic system based on engine oil (→ Page 23) (with PowerPack first manufactured before approx. 2023)
- Chapter on the hydraulic system based on hydraulic oil (→ Page 24) (PowerPack first manufactured from approx. 2023)

Important

The distinctive feature between both systems is a new hydraulic oil expansion tank. The following figure shows the new hydraulic oil expansion tank for the hydraulic system based on hydraulic oil.



TD0000119596_000

Figure 3: Hydraulic oil expansion tank with material number X50441300480/87

TIW-ID: 0000117170 - 004

5.2 Hydraulic system based on engine oil

Fluids and lubricants for hydrostatic drive systems (fans, generator drive)

The permissible engine oils in accordance with chapter 2 (→ Page 8) must be used as operating fluids for the hydraulic system.

Engine oils

Important

Mixing different engine oils is strictly prohibited!
Topping up engine oil with a different approved oil brand than currently used in the engine is also strictly prohibited!

For details and special features, see chapter 2 "Lubricants" (→ Page 6).

Hydraulic system

Important

The oil change interval for the hydraulic system is 4000 operating hours/max. two years.
The latest order-specific maintenance schedule can list other change intervals which then supersede the fluids and lubricants specifications.
Mixing different hydraulic oils is strictly prohibited!

Analytical limit values

	Test method	Limit values	
Water content (mg/kg)	ASTM D6304 EN 12937 ISO 6296	< 1000	
Cleanliness class	ISO 4406	19/17/14	

Table 21: Analytical limit values

5.3 Hydraulic system based on hydraulic oil

Hydraulic system

Important

The oil change interval for the hydraulic system is 4000 operating hours/max. two years.
The latest order-specific maintenance schedule can list other change intervals which then supersede the fluids and lubricants specifications.
Mixing different hydraulic oils is strictly prohibited!

Approved hydraulic oils*:

- Shell Panolin S4 HLP Synth 68**
- Shell Tellus S2 VX 68

* = The validity of the approval of the listed products must always be checked based on the latest version of the Bosch Rexroth Fluid Rating at:

<https://www.boschrexroth.com/de/de/search.html?q=fluid+rating&num=10&origin=header&s=download>

** = Use only after consultation with Rolls Royce Solutions Service Application

Analytical limit values

For Shell Panolin S4 HLP Synth 68

	Test method	Limit values	
Water content (mg/kg)	ASTM D6304 EN 12937 ISO 6296	≤ 300	

Table 22: Water content

All other characteristic values must be determined and complied with in accordance with RD 90221 <https://www.boschrexroth.com/de/de/search.html?dnavs=&q=90221&s=download>.

For Shell Tellus S2 VX 68

	Test method	Limit values	
Cleanliness class	ISO 4406	19/17/14	

Table 23: Cleanliness class

All other characteristic values must be determined and complied with in accordance with RD 90220 <https://www.boschrexroth.com/de/de/search.html?dnavs=&q=90220&s=download>.

6 Coolants

6.1 General information

Coolant definition

Coolant	= Coolant additive (concentrate) + freshwater in the specified mixing ratio ready for application in the engine
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Requirements

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 PowerPack.

The corrosion-inhibiting effect of coolants is only ensured with the coolant circuit fully filled. This means that the engine must be preserved when coolant has been drained off and refilling is not planned. Refer to preservation and represervation specifications A001070/.. for a description of the preservation procedure.

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

Important

Never mix different coolant additives and other supplements!

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

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

To prevent cooling system damage:

- For initial filling, an antifreeze concentration of 50% by volume must be ensured in the cooling system.
- For topping up coolant (after a coolant loss) or when the antifreeze concentration falls below 40% by volume, a concentration of 50% by volume must be established in the cooling system.
- To avoid compromising corrosion protection, an antifreeze concentration lower than 40% by volume is inadmissible.
- As a general rule, do not use an antifreeze concentration of more than 55% by volume. 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).
- A coolant circuit cannot usually be drained completely, i.e. residual quantities of used coolant or freshwater from a flushing procedure remain in the engine. These residual quantities can result in the dilution of a coolant to be filled (mixed from a concentrate or use of a ready mixture). 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.

Coolant mixing ratio

Antifreeze protection down to °C ¹⁾	-25	-31	-37	-45
Water % by volume	60	55	50	45
Antifreeze % by volume	40	45	50	55

¹⁾ = Antifreeze specifications determined as per ASTM D1177

Table 24: Coolant mixing ratio

Calculating antifreeze quantity for refilling

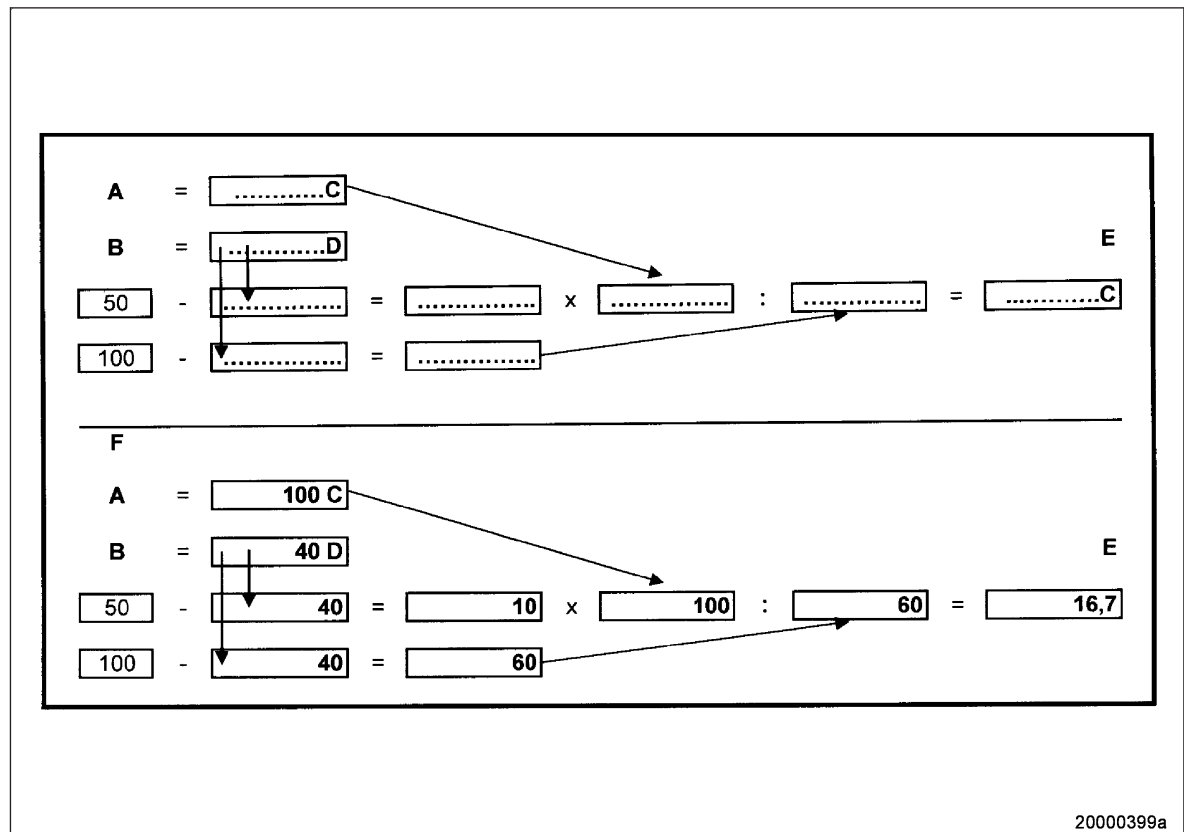


Figure 4: Calculation example

A Coolant capacity (total)
B Measured concentration

C Liters
D Percent by volume

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

F Calculation example

Engine coolant or coolant additives

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

Manufacturer and sales region	Product name	Model
Rolls-Royce Solutions GmbH Rolls-Royce Solutions Asia Europe Middle East Africa Asia	Coolant AH 100 Antifreeze Concentrate	1)
	Coolant AO 100 Antifreeze Concentrate	1)
	Coolant AS 100 Antifreeze Concentrate	1)
	Coolant AH 50/50 Antifreeze Pre-mix	1)
Rolls-Royce Solutions America Inc. America	Power Cool® Universal 50/50 mix	800069 (1 gallon) 800071 (5 gallons) 800084 (55 gallons)

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.

Table 25: Engine coolant or coolant additives

Special properties

mtu ValueCare – Coolants and premixes

Important

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

The alternative products listed in table (→ Table 26) are compatible when refilling and in the presence of residual quantities when changing coolant.

The products listed in table (→ Table 26) are based on the latest knowledge available at the time of publication of the Rolls Royce Solutions fluids and lubricants specifications.

For all other coolants specified in the Rolls Royce Solutions 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 Kühler-schutz 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 KG

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 G-48 premix 50%	Valvoline
	OEM Advanced 48 premix 50%	
	Hoyer Freeze A48 RM 50:50	Wilhelm Hoyer B.V. & Co.KG

Table 26:

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

The alternative products listed in table (→ Table 27) are compatible when refilling and in the presence of residual quantities when changing coolant.

The products listed in table (→ Table 27) are based on the latest knowledge available at the time of publication of the Rolls Royce Solutions fluids and lubricants specifications.

For all other coolants specified in the Rolls Royce Solutions 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 G-30	Valvoline
	OEM Advanced 30	
	Hoyer Freeze A30	Wilhelm Hoyer B.V. & Co.KG

Table 27:

Important

The production and distribution of the coolant AS, and ready mixtures based on it, will be discontinued by Rolls Royce Solutions for operational reasons.

The alternative products listed in table (→ Table 28) are compatible when refilling and in the presence of residual quantities when changing coolant.

The products listed in table (→ Table 28) are based on the latest knowledge available at the time of publication of the Rolls Royce Solutions fluids and lubricants specifications.

For all other coolants specified in the Rolls Royce Solutions 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 G 40	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 G-40	Valvoline
	OEM Advanced 40	
	Hoyer Freeze A40	Wilhelm Hoyer B.V. & Co.KG

Table 28:

6.2 Unsuitable materials in the coolant circuit

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 starts to leak 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 return/drain lines as well as to storage bins.
- 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. Use coolants with purely organic inhibitors if copper alloys are involved.

Non-metallic materials

- Do not use EPDM or silicon 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.

6.3 Freshwater

Freshwater

Only clean, clear water with values in accordance with those in the following table can be used for preparing the coolant. If the limit values for the water are not achieved, its hardness or mineral content can be decreased by adding demineralized water.

	Min.	Max.
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
Sulfate ions		100 mg/l
Total chloride + sulfate ions		200 mg/l
Bacteria		10 ³ CFU (colony forming unit)
Fungi, yeasts	Not permitted!	
¹⁾ Common designations for water hardness in various countries:		

Table 29: Values for freshwater

6.4 Operational monitoring

Operational monitoring

Analysis of the freshwater and continuous monitoring of the coolant are essential for trouble-free PowerPack operation. The freshwater and the coolant should be checked each time they are topped up, at least once a year or after 3000 operating hours. This check can be carried out with the test kit (→ Table 29) 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).		
Analysis	Method for on-site checks (Test kit) (→ Table 29)	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 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 e.g. freshwater		Dip slides (tube with culture medium, e.g. VWR Prolabo No. 535112D or equivalent) incubation time: Four days at 30 °C

Table 30: Minimum requirements and methodology for coolant monitoring

Orders for freshwater and coolant analysis may be placed with Rolls-Royce Solutions. In particular cases, operational monitoring can cover more checks than those listed in table (→ Table 30). Consult your contact if necessary.

The routine check of the coolant in accordance with table (→ Table 30) 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.

Limit values for coolants

pH value when using – Antifreeze (ASTM D1287, ISO 976)	Min. 7.5	Max. 9.0
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Silicon content (ICP) – Applies to coolants containing Si	Min. 25 mg/l	
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Table 31:

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

Note:

In addition to the aforementioned limit values, the respective coolant-specific characteristic data and the fresh-water quality used must also be taken into consideration for a comprehensive appraisal of coolant functionality.

6.5 Coolant concentrates – Storage capability

Coolant concentrates – Storage capability

Antifreeze	Approx. 3 years	Observe manufacturer's specifications
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The storage capability specifications refer to coolant concentrates in original, hermetically sealed packing with storage temperatures up to max. 30 °C.

Note:

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. Frost protection must be provided in winter.

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

6.6 Color additives to detect leakage in the coolant circuit

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 leakages.

Manufacturer	Product name	Material number	Container size	Storage stability ¹⁾
Chromatech Inc. Chromatech Europe B.V.	D 11014 Chromatint Uranine Conc	X00066947	20 kg	Two years

Table 32: Approved color additives

¹⁾ = Based on original and hermetically sealed containers in frost-free storage (> 5 °C).

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.

6.7 Coolant operating times

Coolant change interval

The first coolant change after delivery of the PowerPack with an approved coolant must be carried out after one year or 3000 operating hours (whichever comes first).

Before refilling with fresh coolant, the entire coolant circuit of the PowerPack must be flushed with suitable freshwater. This prevents residual quantities of the aged/contaminated coolant from being carried over into the fresh coolant.

Further coolant changes must then be performed every three years.

The shortened interval for the first coolant change only refers to the coolants for engine cooling (→ Page 37) and (→ Page 41), but not to the coolant for battery cooling (→ Page 44) in hybrid applications of the PowerPack.

The shortened coolant change interval for engine cooling also comes into play if the installation of new water coolers is required for a valid reason.

All the coolant must always be changed. Changing the coolant only for the PowerPack by shutting off the vehicle valves of the heating system is not permitted.

6.8 Approved Coolants

6.8.1 Antifreeze containing silicon

Important

Shortened coolant change interval when filling the PowerPack for the first time and if the installation of new water coolers is required for a valid reason.
The chapter on "Coolant operating times" (→ Page 36) must always be observed here!

For details and special information, see chapter 6 "Coolants" (→ Page 25)

Special arrangements presently in effect remain valid.

Important

Never mix different coolant additives and other supplements!
Before changing from an antifreeze concentrate containing silicates to a silicate-free antifreeze concentrate, flush the coolant circuit with freshwater.
Before changing from a silicate-free antifreeze concentrate to an antifreeze concentrate containing silicates, flush the coolant circuit with freshwater.

Antifreeze concentrates

Manufacturer	Brand name	Inhibitors							Operating time Hours/years	Comments/ material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AH100 Anti-freeze Concentrate	X	X				X	X	-/3	No longer included in portfolio. Re-maining stocks of this product can be used up as long as they are within their shelf life.
	Coolant AS100 Anti-freeze Concentrate	X	X						-/3	
BASF SE	Glysantin® G05		X	X			X		-/3	
	Glysantin® G48 blue green	X	X				X	X	-/3	X00058054 (25 l) X00058053 (210 l)
	Glysantin® G40 pink (Konzentrat)	X	X						-/3	X00066714 (20 l) X00066725 (210 l)
	Glysantin® G40 ECO pink BMB 100	X	X						-/3	
BayWa AG	Tectrol Coolprotect	X	X				X	X	-/3	
Castrol	Castrol Radicool NF	X	X				X	X	-/3	
Classic Schmierstoff GmbH & Co KG	Classic Kolda UE G40®	X	X						-/3	
COPARTS Autoteile GmbH	CAR 1 Premium Longlife Kühlerschutz C48	X	X				X	X	-/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F40	X	X						-/3	
	AVIATICON Finkofreeze F48	X	X				X	X	-/3	

Manufacturer	Brand name	Inhibitors							Operating time Hours/years	Comments/ material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Fuchs SE	Fricofin	X	X				X	X	-/3	
	Fricofin DP	X	X						-/3	
Krafft S.L.U.	Refrigerante ACU 2300		X	X			X		-/3	X00058075 (barrel)
LAEMMLE Chemicals AG	ROXOR ANTI-FROST MT-325	X	X				X	X	-/3	
	ROXOR ANTI-FROST MT-650	X	X						-/3	
Mitan Mineralöl GmbH	Alpine C48	X	X				X	X	-/3	
Moove Lubricants Limited	Mobil Antifreeze Extra	X	X				X	X	-/3	
Motorex AG	Motorex Coolant G48	X	X				X	X	-/3	
Nalco Water An Eco-lab Company	Nalcool NF 48 C	X	X				X	X	-/3	
Puma Energy International S.A.	Puma HD Hybrid Coolant	X	X						-/3	
Raloy Lubricantes	Antifreeze Long Life NF-300 Concentrate	X	X				X	X	-/3	
Total Lubrifiants	Glacelf MDX	X	X				X	X	-/3	
Valvoline	Zerex G 05		X	X			X		-/3	
	Zerex G 40	X	X						-/3	Material number (USA): 800180 (drum)
	Zerex G 48	X	X				X	X	-/3	
	OEM Advanced 05		X	X			X		-/3	
	OEM Advanced 40	X	X						-/3	
	OEM Advanced 48	X	X				X	X	-/3	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A40	X	X						-/3	
	Hoyer Freeze A48	X	X				X	X	-/3	

Table 33:

Antifreeze ready mixtures

Manufacturer	Brand name	Inhibitors							Operating time Hours/years	Comments/ material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Rolls-Royce Solutions GmbH	Coolant AH 50/50 Anti-freeze Premix	X	X				X	X	-/3	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 50/50 mix	X	X				X	X	-/3	800071 (5 gallons) 800084 (55 gallons)
	Power Cool® Off-Highway Coolant 50/50 Premix		X	X			X		-/3	23533531 (5 gallons) 23533532 (55 gallons)
BASF SE	Glysantin® G40 RM/50 ECO pink BMB 100	X	X						-/3	50% by volume
Castrol Ltd.	Castrol Radicool NF Premix (45%)	X	X				X	X	-/3	
Cepsa Comercial Petróleo S.A.U.	XTAR Super Coolant Hybrid NF 50%	X	X				X	X	-/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F48 RM 50/50	X	X				X	X	-/3	
Fuchs SE	Fricofin DP 50	X	X						-/3	50% by volume
	Fricofin 50	X	X				X	X	-/3	50% by volume
Motorex AG	Motorex Coolant G48 Ready to use (50/50)	X	X				X	X	-/3	
Moove Lubricants Limited	Mobil Coolant Extra Ready -36 °C	X	X				X	X	-/3	50% by volume
Puma Energy International S.A.	Puma HD Hybrid Coolant 5050	X	X						-/3	
Raloy Lubricantes	Antifreeze Long Life NF-300 Ready-to-Use (50:50)	X	X				X	X	-/3	
SMB - Sotragal / Mont Blanc	FRICOTECH MBT SMB Auto -37 °C	X	X						-/3	50% by volume
Total Lubrifiants	Total Coolelf MDX -37	X	X				X	X	-/3	50% by volume

Manufacturer	Brand name	Inhibitors							Operating time Hours/years	Comments/ material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Valvoline	Zerex G05 50/50 Mix Antifreeze		X	X			X		-/3	
	OEM Advanced 48 premix 50%	X	X				X	X	-/3	
	Zerex G-48 premix 50%	X	X				X	X	-/3	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A48 RM 50:50	X	X				X	X	-/3	

Table 34:

6.8.2 Antifreeze without silicon

Important

Shortened coolant change interval when filling the PowerPack for the first time and if the installation of new water coolers is required for a valid reason.

The chapter on "Coolant operating times" (→ Page 36) must always be observed here!

For details and special information, see chapter 6 "Coolants" (→ Page 25)

Special arrangements presently in effect remain valid.

Important

Never mix different coolant additives and other supplements!

Before changing from a silicate-free antifreeze concentrate to an antifreeze concentrate containing silicates, flush the coolant circuit with freshwater.

Before changing from an antifreeze concentrate containing silicates to a silicate-free antifreeze concentrate, flush the coolant circuit with freshwater.

Antifreeze concentrates

Manufacturer	Brand name	Inhibitors						Operating time Hours/years	Comments/ material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates		
Rolls-Royce Solutions GmbH	Coolant AO 100 Antifreeze Concentrate	X						-/3	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						-/3	
BASF SE	Glysantin® G30 pink	X						-/3	X00058072 (canister) X00058071 (barrel)
	Glysantin® G30 ECO pink BMB 100	X						-/3	
CCI Corporation	L 415	X				X		-/3	
Classic Schmierstoff GmbH & Co. KG	Classic Kolda UE G30®	X						-/3	
Daimler Trucks North America	Alliance OAT Extended Life Coolant	X				X		-/3	
Detroit Diesel Corp.	Power Cool Plus Coolant	X				X		-/3	
Drew Marine	Drewgard ZX	X						-/3	
ExxonMobil	Mobil Delvac Extended Life Coolant	X				X		-/3	
Finke Mineralölwerk GmbH	AVIATICON Finkofreeze F30	X						-/3	
Fuchs SE	Fricofin G12	X						-/3	
Mitan Mineralöl GmbH	Alpine C30	X						-/3	
MJL Bangladesh Ltd.	Omera Premium Coolant	X						-/3	

Manufacturer	Brand name	Inhibitors							Operating time Hours/years	Comments/ material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
Navistar Inc.	Fleetrite Nitrite-Free Extended Life Coolant	X				X			-/3	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Coolant	X				X			-/3	
	Final Charge Global Extended Life Coolant Anti-freeze	X				X			-/3	
Recochem	HD Expert TM Endurance	X				X			-/3	
Valvoline	Zerex G 30	X							-/3	
	OEM Advanced 30	X							-/3	
Volvo Trucks	Road Choice Nitrite-Free OAT Extended Life Coolant	X				X			-/3	
Wilhelm Hoyer B.V. & Co.KG	Hoyer Freeze A30	X							-/3	

Table 35:

Antifreeze – Ready mixtures

Manufacturer	Brand name	Inhibitors							Operating time Hours/years	Comments/ material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS		
BASF SE	Glysantin® G30 RM/50 ECO pink BMB 100	X							-/3	
CCI Corporation	L 415 (50 %)	X				X			-/3	
Daimler Trucks North America	Alliance 50/50 Prediluted OAT Extended Life Coolant	X				X			-/3	
Detroit Diesel Corp.	Power Cool Plus Prediluted Coolant (50/50)	X				X			-/3	
Exxon Mobil	Mobil Delvac Extended Life Prediluted Coolant (50/50)	X				X			-/3	
Fast Chemical SRL	Fast Coolant G30 50%	X							-/3	
Navistar Inc.	Fleetrite 50/50 Prediluted Nitrite-Free Life Coolant	X				X			-/3	
Old World Industries Inc.	Blue Mountain Heavy Duty Extended Life Prediluted Coolant (50/50)	X				X			-/3	
	Final Charge Global Extended Life Prediluted Coolant/Antifreeze (50/50)	X				X			-/3	

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Manufacturer	Brand name	Inhibitors						Operating time Hours/years	Comments/ material number
		Organic	Silicon	Nitrite	Phosphate	Molybdate	Borates	2-EHS	
Recochem	HD Expert TM Endurance 50-50 Prediluted	X				X			-/3
Volvo Trucks	Road Choice 50/50 Pre- diluted Nitrite-Free OAT Extended Life Coolant	X				X			-/3
YPF S.A. Argentina	Kriox MTL50	X				X			-/3 50%

Table 36:

6.8.3 Coolant for battery cooling

For details and special information, see chapter 6 "Coolants" (→ Page 25)

Special arrangements presently in effect remain valid.

Important
Never mix different coolant additives and other supplements!
Before changing from an antifreeze concentrate containing silicates to a silicate-free antifreeze concentrate, flush the coolant circuit with freshwater.
Before changing from a silicate-free antifreeze concentrate to an antifreeze concentrate containing silicates, flush the coolant circuit with freshwater.

Corrosion-inhibiting antifreeze concentrates for battery cooling

Manufacturer	Brand name	Operating time Hours/years	Comments
BASF	Glysantin G48	-/1	Mixed with 50% pure water
	Glysantin G30	-/1	Mixed with 50% pure water
Clariant	Antifrogen N	-/1	Mixed with 50% pure water

Table 37:

7 Liquid Fuels

7.1 Fuels

Diesel fuels

Selecting a suitable diesel fuel

The quality of the fuel is very important for optimum engine operation, long engine service life, and retaining the emission certificate and the associated operating approval.

Important

The corresponding Daimler Truck operating instructions must always be observed, and the latest version of these constitutes the most important document.
The corresponding operating instructions can be found at: <https://manuals.daimlertruck.com/truckownermanuals/home>

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

Limit values for water and total contamination

		Test methods		Limit values
		ASTM	ISO	
Water content	Max.	D6304	EN 12937	200 mg/kg
Total contamination	Max.	D6217	EN 12662	24 mg/kg
Particle distribution for fuel in tanks	Max.		ISO 4406	ISO classes 18/17/14

Table 38:

To maintain the perfect fuel condition, Rolls-Royce Solutions strongly recommends integrating an appropriate prefilter in the side of the fuel system that draws in the fuel.

Important

The use of fuels which have not been approved can lead to considerable deviations from the specified engine power and to severe engine damage.
Use of non-approved fuels leads to loss of the emission certificate!
If fuels which have not been approved are used, shorter oil change intervals are to be expected.
Prior to using non-approved fuels, contact Rolls-Royce Solutions to determine the applicable oil change intervals.
Operating the engines with biodiesel/FAME according to DIN EN 14214 curtails the oil change intervals, see "Engine oil and maintenance" (→ Page 47).
If a switch is made from one approved fuel to another, an immediate filter change of all fuel filters is recommended.
In addition, the filters must be checked over a limited period of time to prevent blockages caused by cleaning and flocculation processes, and thus avoid unplanned operational problems. Once the filter conditions have stabilized, the additional filter check can be omitted.
Dispose of used fluids and lubricants in accordance with local regulations!

Requirements

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

Distillate fuels

	Diesel fuel according to DIN EN 590	ASTM D975 Grade 2-D		BS 2869:2023 Part 1 Class A2	EN 15940 ¹⁾
		S15	S500		
Euro 3	Approval granted	Approval granted	Approval granted	Approval granted	Approval not granted
Up to EU Stage IIIA/ EPA Tier 3	Approval granted	Approval granted	Conditional approval ²⁾	Approval granted	Approval granted
From EU Stage IIIB/ EPA Tier 4i	Approval granted	Approval granted	Conditional approval ²⁾	Approval granted	Approval not granted
EU Stage V	Approval granted	Approval granted	Approval not granted	Approval granted	Approval granted

Table 39:

¹⁾ = Increased additional volumetric consumption or marginal power loss due to reduced density possible.

²⁾ = Note on D975 Grade 2 with high sulfur content, S500:

- Curtails the maintenance intervals of all oil changes by a factor of 2–3 and increases wear, adapted oil grades required.
- Increases particulate emissions significantly compared with the certification limit.
- Operation therefore only admissible in regions which permit such levels.

Biodiesel

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

Important
The basic configuration of the PowerPack is not equipped with a fuel system suitable for FAME. Before using biodiesel (FAME) fuels or diesel fuels with FAME contents exceeding the limit values of DIN EN 590, the fuel system of the PowerPack must be modified. Consultation with Rolls-Royce Solutions is mandatory! The use of diesel fuels with FAME content according to DIN EN 590 does not present a problem. This fuel has no influence on the oil change intervals. Consult Rolls-Royce Solutions GmbH if the FAME content is higher.

Approval/requirements for the engine/PowerPack for operation with 100% FAME – generally not admissible for EU Stage IIIB engines and higher

Engine/series	Approval/requirements
PowerPack 6H 1800 Euro 3/EU Stage IIIA	Only with optional equipment for Euro 3
Engine 6H 1800 Euro 3/EU Stage IIIA	Approved as from series production

Table 40:

Fuel (FAME)

- The fuel must comply with DIN EN 14214. 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 normal diesel fuel which can occur in the vehicle tank as a result do not present a problem.

Engine oil and servicing

- A certain amount of fuel always finds its way into the engine oil via the pistons and cylinders. Its high boiling point means that FAME does not evaporate but remains in the engine oil in its entirety. Under certain conditions, chemical reactions may take place between FAME and the engine oil. This can lead to engine damage.
- For this reason, engine oil and oil filter change intervals must be shortened for operation both with pure FAME and with FAME-diesel mixtures.
- For Series 460/1800, special equipment is available which facilitates an extension of the engine oil change intervals for operation with 100% FAME. For this application, the engines must be fitted with special equipment, i.e. special unit pumps and a fuel prefilter with heated water separator on the frame.

Engine version	Engine oil change interval
Engines not fitted with special equipment for operation with FAME	Reduction of the engine oil change interval to 30% of the operating hours
Engines with special equipment: • Special unit pump • Fuel prefilter with heated water separator on the vehicle frame	Reduction of the engine oil change interval to 50% of the operating hours

Table 41:

Important
The relevant engine oil change and filter replacement intervals must be complied with without fail! Exceeding the engine oil change intervals can cause engine damage!

- Operation with 100% FAME requires shortened fuel filter change intervals. A new fuel filter must be fitted each time the engine oil is changed.
- Fuel and engine oil must be changed and the fuel filter must be changed approximately 25 operating hours after conversion to FAME due to the danger of blockage caused by loosened deposits (FAME has a pronounced cleaning effect).
- Over longer periods, fuel filter service life can be reduced as a result of old residues being carried into the filter from the fuel system. A special, approved fuel prefilter can be installed as an improvement.

Engine power and engine standstill

- Due to its calorific value, operation with 100% FAME involves a reduction of approx. 8% to 10% in engine power. This leads to a corresponding increase in fuel consumption as compared to operation with diesel fuel. Engine power corrections are not permissible.
- Prior to any extended period out of operation, the fuel system must be flushed out in order to prevent congestion. For flushing, the engine must be operated for at least 30 minutes on diesel fuel (without FAME).

General notes

- We can make no comment with regard to the level of FAME resistance of the fuel system, which is not part of our scope of supply.
- FAME is an extremely effective solvent. Any contact with varnish, for example, must therefore be avoided.
- 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.

Important
Our company accepts no responsibility for and provides no warranty in respect of any fault or damage connected in any way with the use of FAME of a lower quality or resulting from non-compliance with our specifications on operation using FAME. All resultant irregularities and consequential damage are outside our area of responsibility.

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 the absence of standardization and to negative experience (engine damage caused by coking, deposits in the combustion chambers and oil sludge).

Low-sulfur diesel fuels

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

Diesel fuels in winter operation

At low outdoor temperatures, diesel fuel fluidity can be inadequate as a result of paraffin precipitation.

In order to prevent operational problems (e.g. clogged filters) during the winter months, diesel fuel with suitable cold-flow characteristics must be used.

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 analyses of the filtering capability.

Required quantities and mixing procedures must be carried out according to the manufacturer's instructions.

7.2 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 (that contain e.g. ferrocene, cerium, etc.) are added 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.

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.

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

Approved biocides

Manufacturer	Brand name	Use concentration
Schülke und Mayr 22840 Norderstedt Tel. +49 (0) 40/52100-00 Fax +49 (0) 40/52100-244	Grota MAR 71	0.5 l/ton
Vink Chemicals GmbH &Co. KG Eichenöhe 29 D-2255 Kakenstorf Tel. +49 (0) 4186/88797 Fax +49 (0) 4186/88797-10	grotamar®82	

Table 42:

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

8.1 General

SCR (Selective Catalytic Reduction) catalysts can be used to reduce NO_x emissions. The reducing agent (aqueous urea solution (reducing agent with a concentration of 32.5% urea)) in such catalysts reduces the nitrogen oxide emissions.

In addition to ensuring compliance with exhaust emission requirements, reducing agents are used to safeguard the functionality of the exhaust gas aftertreatment system throughout its useful life. The reason for this is that the reducing agent is used to cool some of the component parts of the exhaust gas aftertreatment system (e.g. the reducing agent dosing units). Furthermore, some of the component parts of the exhaust gas aftertreatment system (e.g. the reducing agent supply units) can become clogged and damaged as a result of crystallization. Basically, the exhaust gas aftertreatment system can only be operated with a sufficient quantity of reducing agent filled in the reducing agent tank. To avoid damaging the system, only downtimes lasting less than < 24 h are acceptable from a technical point of view. Longer downtimes > 24 h without using reducing agent will damage the component parts of the exhaust gas aftertreatment system.

To ensure efficient operation of the exhaust gas aftertreatment system, the reducing agent must comply with the quality requirements stipulated in DIN 70070 / ISO 22241-1.

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

The testing procedures to determine the quality and characteristics of the reducing agent are specified in the standards DIN 70071 / ISO 22241-2.

Important

SCR systems from Rolls-Royce Solutions are designed for a concentration of 32.5% urea. The use of NO_x reducing agents with other concentrations of urea (AUS 40, AUS 48) is not approved!
The use of antifreeze additives for AUS 32, or winter urea, is generally not approved!

8.2 Reducing agent storage

For instructions on storage, packing, and transport, refer to the ISO 22241-3 standard. The instructions of the manufacturer must be observed.

Storage temperatures according to ISO 22241-3: max. 30 °C, min. -5 °C

The reducing agent crystallizes at -11 °C.

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

9 Flushing and Cleaning Instructions

9.1 General information

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 conditions 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 (→ Page 53) (no river or sea water) must be used for flushing.

Only products approved by Rolls-Royce Solutions or corresponding products (→ Page 59) at the specified concentrations can 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 these fluids and lubricants specifications (→ Page 25). 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 substances. 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 for improper or illegal use of the fluids and lubricants or cleaning agents which it has approved.

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 42) 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.cmttechnologies.de>).

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 43: Values for freshwater

¹⁾ = Common designations for water hardness in various countries: 1 mmol/l = 5.6°d = 100 mg/kg CaCO₃

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

9.3 Coolant Circuits

9.3.1 Engine coolant circuits – Flushing

1. Drain engine coolant.
2. Use test kit or electrical pH meter to measure pH value of freshwater.

Important

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

3. Fill coolant circuit with freshwater.

Important

Do not pour cold water into a hot engine!
Refer to engine operating instructions 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 valve.
8. Drain flushing water.
9. Use test kit or electrical pH meter to measure pH value of flushing water sample and compare with pH value of freshwater.
10. If pH value difference is still too large even after flushing four to five times: Clean coolant circuit, see (→ Page 55) (→ Page 57)

9.3.2 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 59).
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 the 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 engine coolant circuit with freshwater.
9. Take flushing water sample at engine coolant sample extraction valve.
10. Use test kit or electrical pH meter to measure pH value of flushing water sample and compare with pH value of freshwater.

Important

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

Refer to engine operating instructions for additional information

9.3.3 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.

9.3.4 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 59)

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 54).
12. Check coolant system for leaks during initial operation of engine.

Important

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

9.3.5 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 59), 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 59) 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!

9.3.6 Approved cleaning agents/disinfecting agents

Approved cleaning agents

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

Table 44:

Approved disinfecting agents

Manufacturer	Product category	Application 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 45:

¹⁾ = For light lime deposits, light corrosion

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

³⁾ = For oily and greasy residues. Not suitable for galvanized surfaces

⁴⁾ = Can only be used for cleaning Series 4000 generator set coolant system contaminated by copper phosphate particles

⁵⁾ = For lime deposits containing oil and grease

⁶⁾ = Not stocked by Rolls-Royce Solutions.

⁷⁾ =

For heavy lime deposits, preferred

⁸⁾ = Solvent cold cleaner for oily and greasy residues

⁹⁾ = Bacteria contamination $\geq 10^5$, contamination with fungi and yeast not permitted
Note application cases (→ Page 58).

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 58).

¹¹⁾ = For application in the field. The smaller canister is easier to handle.

Note application cases (→ Page 58).

Important

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

The cleaners are available worldwide through the subsidiaries of the manufacturers or their trading partners.

9.4 Cleaning the Product Externally

9.4.1 General

If, over 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 into 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 the chapter "Fresh water requirements for cleaning solutions and flushing water" (→ Page 53) are also applicable 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 substances. 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 must therefore undertake to inform themselves of the locally valid regulations. Rolls-Royce Solutions accepts no liability 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 (www.cmtechnologies.de).

Test kit or electrical pH meter

- Freshwater
- Superheated steam
- Compressed air

9.4.2 Approved cleaning agents

Manufacturer	Product category	Application concentration		Order number
For the air side of external coolers:				
Kluthe GmbH	Hakupur 50-136 ¹⁾	2% by volume	Liquid	X00056700
For external cleaning and painted, contaminated surfaces:				
Kluthe GmbH	Hakupur 449 ³⁾	1% by volume	Liquid	X00071179 ²⁾

Table 46: Approved cleaning agents

¹⁾ For cleaning instructions, see the Operating Instructions supplied with/accompanying the PowerPack.

²⁾ Not stocked by Rolls-Royce Solutions.

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 cleaners are available worldwide through the subsidiaries of the manufacturers or their trading partners.

10 Revision Overview

10.1 Revision overview from version A001062/05 to A001062/06

General

This publication applies to Series 1800 PowerPacks only.

All the relevant information on other mtu Series and mtu-DD Series S60 can be found in the Fluids and Lubricants Specifications for the respective engine models, which you can find here:

www.mtu-solutions.com

Changes

Serial No.	Page	Chapter	Subchapter	Action	Supplement/ comments
1		Title page	Cover page	Revised	
2	(→ Page 4)	Preface		Revised	Added: Fluids and Lubricants – Change
Engine oils					
3	(→ Page 6)	Engine oils	General	Revised	Complete chapter
Transmission oils					
4	(→ Page 18)	Transmission oils	Transmission oils for Voith transmissions	Revised	Complete subchapter
Flushing and cleaning instructions					
5	(→ Page 59)	Flushing and Cleaning Instructions	Approved cleaning agents/disinfecting agents	Revised	Complete subchapter
Revision overview					
6	(→ Page 62)	Revision overview	Revision overview from version A00106204 to A00106205	Revised	Complete subchapter

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